0693 0694 0695 0696	Deep Channel	Yellow- fin (~100)	Light muscle Dark muscle Liver Bone	$ \begin{array}{r} 15 \pm 1.1 \\ 9.7 \pm 1.2 \\ \text{NC} \\ 2.5 \pm 0.6 \end{array} $	$\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$	$\begin{array}{c} 0.14\\ 8.4 \pm 1.3\\ 2.1 \pm 0.3\\ \leq 0.04 \end{array}$	NC NC NC NC	0.0° 0.12 0.30 0.03	0.07 0.24 0.02	0,04 0,16 0,08 0,02	$0^{+}01 \to 0^{+}002$ $0^{+}001$ $0^{+}03$
0440 0442 0443	ELMER	Macke rel (47,41)	Viscera Muscle Muscle	$\begin{array}{cccc} 9.7 \pm 1.6 \\ 20 \pm 1.4 \\ 20 \pm 1.4 \end{array}$	$\begin{array}{cccc} 240 & \pm 2.9 \\ 6.5 & \pm 0.3 \\ 10 & \pm 0.4 \end{array}$	2.7 ± 0.25 ~ 0.23 0.68 ± 0.15	NC NC NC	0.20 0.17 ± 0.07 0.21 ± 0.07	0.98 ± 0.10 0.09 ± 0.04 0.06	$\begin{array}{c} 0.34 \\ 0.097 \\ 0.10 \end{array}$	0.011 0.002 0.006
0572 0574 0573	GLENN	Mackerel (~45)	Muscle Viscera Bone	18 : 1.5 NC 18 : 4.1	11 ± 0,3 210 ± 6,4 580 ± 10	$\begin{array}{c} 0.37 \pm 0.07 \\ 5.3 \pm 1.6 \\ 0.61 \pm 0.18 \end{array}$	NC NC NC	0.24 ± 0.06 0.36 ± 0.20	0,05 0,34 0,17	0.20 1.3 1.1	$\begin{array}{c} 0.009 \\ 0.002 \pm 0.001 \\ 0.014 \pm 0.002 \end{array}$
0706 0707	Wide Pass	1)olphin (~100)	Muscle Liver	$\begin{array}{c}15\\10\\1\end{array} + 1.3\\1\end{array}$	45 ± 1,3	0.67 ± 0.18 13 ± 0.5	NC NC	0.20 ± 0.07 0.16	0.09 ± 0.04 • 0.13	0.005 ± 0.003 0.02	0.016 ± 0.001 0.035 ± 0.003
0540 0541	ELMER	Dolphin (80)	Muscle Liver	$\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$	≤0.9 30 ±5,9	$\begin{array}{c} 0.14\\ 0.98\pm 0.37\end{array}$	NC NC	0.09 0.30	0.07 0.67	13, } ()	0,003 0,07 → 0,03
0769 0770	MIKE Crater	Barra- cuda (~60)	Muscle Bone	$ \begin{array}{r} 16 & \pm 1.3 \\ 6.3 & \pm 0.9 \end{array} $	_	0.55 ± 0.07 0.38 ± 0.06	NC NC	1.6 ± 0.10 0.48 ± 0.07	28 ± 0.5 2.7 ± 0.1	0.05 ± 0.01 0.15 ± 0.01	0,24 + 0,02

^aError values are one-sigma, counting errors.

^bEach tissue sample is from an individual fish except for No. 0440 which is a composite sample from two fish.

^cNC = not computed.

difference in the ⁶⁰Co concentration in muscle tissue of skipjack captured near YVONNE as compared to those captured near the southern end of the atoll.

Zinc-65, was found only in the liver of the skipjack. Seven (65 Zn in one liver was not computed) skipjack livers had detectable levels of 65 Zn ranging from 1.5 to 6.6 pCi/g, dry, and averaged 2.9 pCi/g, dry. Two skipjack and one wahoo from Kwajalein Atoll also had average 65 Zn concentrations of 0.9 pCi/g, dry, in their livers, indicating that at least a part of the 65 Zn present in the Enewetak skipjack is from worldwide fallout.

Cesium-137 and 207 Bi were found in about 50% of the samples, usually at levels below 1 pCi/g, dry. Cesium-137 was found mainly in the muscle tissue and was evenly distributed between light and dark muscle. However, the highest 137 Cs level was found in the liver of a skipjack from the lagoon off WALT Island. Bismuth-207 was also at its highest level (6.1 pCi/g, dry) in the dark muscle tissue of this skipjack. However, 207 Bi was generally higher in the liver or viscera of a fish than in the muscle.

The only ²⁴¹Am detected in the offshore lagoon fish was also found in the above-mentioned skipjack from WALT. This fish had an ²⁴¹Am concentration of 0.35 pCi/g, dry, in its light muscle and 0.83 pCi/g, dry, in its liver.

Strontium-90 and 239,240 Pu analyses indicate that these radionuclides are generally found in concentrations < 0.1 pCi/g, dry. The highest 90 Sr levels in the pelagic fish are found in barracuda bone (0.15 pCi/g, dry), while the highest 239,240 Pu concentration (1.2 pCi/g, dry) was in the light muscle of a skipjack collected in the Wide Pass.

Summary and Conclusions

Of the man-made radionuclides, 60 Co and 55 Fe are found in the greatest abundance in the nearshore fish, followed by 207 Bi, 155 Eu, 137 Cs, and 241 Am in order of decreasing abundance. All these radionuclides except 137 Cs are present in greater concentrations in the viscera as compared to eviscerated whole fish. Cesium-137 is about equally distributed in the viscera and eviscerated whole fish

In general, nearshore fish collected from IRENE had the highest levels of 55 Fe, 60 Co, 137 Cs, 155 Eu, and 241 Am, while 207 Bi was highest in an ulua from HENRY.

Iron-55 concentrations were generally highest in the liver or dark muscle of the tuna and in the viscera of goatfish, however, a grouper liver from FRED had the highest individual value, 4900 pCi/g, dry, of any sample analyzed. Iron-55 concentrations were higher by a factor of 10 or more in liver or viscera than in light muscle or eviscerated whole fish.

Cobalt-60 concentrations in the nearshore fish ranged from non-detectable amounts to 400 pCi/g, dry, in the viscera of butterfly fish from IRENE. Most 60 Co values for these fish were less than 5 pCi/g, dry.

Cobalt-60 concentrations in Enewetak lagoon fish ranged up to 36 pCi/g, dry, in the liver of a skipjack from near YVONNE. Although the average 60 Co concentration in the tissue samples of three skipjack captured near YVONNE was higher than that found in samples from skipjack in the southern part of the atoll, there was no ipjack

des, ⁶⁰Co est ¹, followed ⁴¹Am in All these present in scera as fish. tributed 'hole fish.)llected els of ²⁴¹Am, 1a from

generally :le of the h, how-) had $) pCi/g_{i}$ on-55 actor than in : fish. e neartable viscera ost ⁶⁰Co 3n 5 ewetak dry, r Co conthree as higher ipjack in : was no

significant difference between the two areas due to the high variability within samples from the same area.

Cobalt-60 concentrations in the liver and muscle of the other lagoon fish was less than it was in the skipjack. No ⁶⁰Co was detected in lagoon fish from Kwajalein. Bismuth-207, ¹⁵⁵Eu, and ¹³⁷Cs were the next most abundant radionuclides. Bismuth-207 concentrations in the small nearshore fish and in snappers and groupers ranged from non-detectable levels up to 24 pCi/g, dry, in the viscera of goatfish from BELLE, and most concentrations were less than 5 pCi/g, dry; however, one ulua from HENRY had a 207 Bi concentration of 240 pCi/g, dry. Europium-155 concentrations in all nearshore fish ranged up to 22 pCi/g, dry, found in the viscera of mullet from IRENE, while average values were less than 1 pCi/g, dry. Cesium-137 concentrations ranged up to 9.6 pCi/g, dry, in mullet viscera from IRENE, but most concentrations were less than 0.5 pCi/g, dry.

Cesium-137 was found in muscle tissue of offshore lagoon fish from Enewetak and Kwajalein Atolls in about the same concentrations (less than 0.5 pCi/g, dry) except for one barracuda captured in MIKE Crater and a skipjack taken off WALT. The barracuda had a 137 Cs concentration of 16 pCi/g, dry, in its muscle tissue, while the skipjack had 2.7 pCi/g, dry, in its liver.

The muscle tissue of the barracuda from MIKE Crater also had the highest ²⁰⁷ Bi level (28 pCi/g, dry) of any offshore lagoon fish from Enewetak Atoll. Bismuth-²⁰⁷ was detected in 14 or 20 samples of skipjack muscle in concentrations up to 6.1 pCi/g, dry, and averaged 1.5 pCi/g, dry. All eight skipjack from Enewetak had detectable ²⁰⁷Bi in their livers in concentrations up to 2.3 pCi[']g, dry, and averaged 0.9 pCi[']g, dry. No significant differences between ²⁰⁷Bi content in the tissues of three skipjack from the YVONNE area and five skipjack from the southern end of the Atoll were noted. Yellowfin tuna had no detectable ²⁰⁷Bi in their tissues, while mackerel and dolphin had low levels in the muscle.

Europium-155 was detected in only one offshore fish sample.

Zinc-65 was found in the liver of skipjack from Enewetak Atoll in concentrations up to 6.6 pCi/g, dry, and averaged 2.9 pCi/g, dry, in the seven skipjack which had detectable levels. Two skipjack livers and one wahoo liver from Kwajalein Atoll also had detectable ⁶⁵Zn concentrations which averaged 0.9 pCi/g, dry, tissue. Zinc-65 was detected only in liver tissue.

Other gamma-emitting radionuclides were present in small amounts on a sporadic basis.

Americium-241 was found almost exclusively in the viscera of fish from BELLE, IRENE, TILDA-URSULA, and YVONNE. Concentrations ranged up to 11 pCi/g, dry, in mullet viscera from IRENE, but averaged less than 1 pCi/g, dry. Plutonium-239, 240 and ⁹⁰Sr concentrations were also high in the viscera of fish from these areas, with the highest concentrations being in the fish from IRENE and BELLE. Large pelagic lagoon fish had lower concentrations of these radionuclides than did the smaller nearshore fish.

There are some differences in radionuclide content of nearshore fish

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	61	OCo in pCi/	g, dry	207 Bi in pCi/g, dry			
Island	1964	1972	Fraction remaining	1964	1972	Fraction remaining	
BELLE	120	16	0.13	8.0	2.0	0.25	
JANET	ະ.3	0.96	0.12	1.2	0.2	0.17	
GLENN	19	3.3	0.17	2.6	0.7	0.27	
LEROY	56	3.4	0.06	5.2	3.1	0.59	
YVONNE	64	5.2	0.08	_		_	
Average			0.11			0.32	

Table 38. Comparison of 60 Co and 207 Bi in the viscera of convict surgeon collected in 1964 and 1972.

associated with feeding habits. The goatfish, a bottom-feeding carnivore, usually contains more 55 Fe, 60 Co, and 207 Bi than the convict surgeon, a grazing herbivore, or the mullet, a detritus feeder. Convict surgeon from BELLE and IRENE did contain more 60 Co than goatfish from IRENE, but goatfish from all other areas had higher 60 Co concentrations than did the convict surgeon from the same area.

A comparison of the present 60 Co and 207 Bi levels in the fish to those found in the 1964 collections (Welander, et al. 1967^{*}) gives some indication of the loss rate of those two radionuclides. From the data presented in Table 38, a rough estimate of the effective half-life for 60 Co (2.7 years) and 207 Bi (5 years) can be deduced. Using these values in the equation, e = PE/P-E, where e =ecological half-life, P = physical halflife, and E = effective half-life, the length of the ecological half-life can be calculated. Ecological half-life is the time required for one-half of the radionuclide in the organism to be lost by processes other than physical decay of the radionuclide during a period when there can be both uptake and loss of the radionuclide but loss is greater than uptake. Thus, the ecological half-life of both ⁶⁰Co and ²⁰⁷Bi in the convict surgeon at Enewetak between 1964 and 1972 is about 6 yr. Comparisons of similar samples of mullet and goatfish give a similar value. Hence, these two radionuclides are being eliminate from these fish at a higher rate than would result from physical decay alone.

In conclusion, fish from the northern portion of the Atoll (BELLE to IRENE) had the highest levels of most radionuclides, fish from the southern portion (DAVID to HENRY) had the lowest activity levels, and fish from intermediate areas (JANET to YVONNE, plus LEROY) had intermediate levels of radioactivity. These activity levels generally correspond to the geographical distribution of activity found in the lagoon sediments.

Invertebrates

Introduction

Selected invertebrates were collected for analysis. Tridacna clams were

^{**}A. D. Welander, et al., <u>Bikini-</u> Eniwetok Studies, 1964: Part II. Radiobiological Studies, USAEC, Rept. UWFL-93 (Pt. II) (1967).

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l**ected** e sampled, since they are both a food item and an indicator organism for ⁶⁰Co. Spiny lobster and top snails are food items, while sea cucumbers might be an indicator organism for plutonium. The invertebrate organisms were not abundant in all locations, but a fair number of Tridacna clams and sea cucumbers were collected from most sampling areas (Table 26). The invertebrates were processed, packaged, gamma-counted, and radiochemically analyzed in the same manner as the fish.

Results and Discussion

The invertebrate samples have been analyzed for gamma-emitting radionuclides, ${}^{55}Fe$, ${}^{90}Sr$, and ${}^{238,239,240}Pu$. The gamma-emitting radionuclides detected by the Ge(Li) diode system included naturally occurring ${}^{40}K$ and ${}^{226}Ra$ and 13 fallout radionuclides - ${}^{54}Mn$, ${}^{60}Co$, ${}^{65}Zn$, ${}^{101}Rn$, ${}^{102M}Rh$, ${}^{108M}Ag$, ${}^{125}Sb$, ${}^{134}Cs$, ${}^{137}Cs$, ${}^{152}Eu$, ${}^{155}Eu$, ${}^{207}Bi$, and ${}^{241}Am$.

Radioactivity values are given as of the date of collection in terms of dry sample weight. Dry weight values may be converted to wet weight values by use of the conversion factors given in Table 25. The Kwajalein invertebrate samples consist of six pooled Tridacna clams, and the data are presented in Table 28. The Enewetak data are presented in Tables 39 (Tridacna), 40 (Sea cucumbers) and 41 (Miscellaneous).

<u>Tridacna Clams</u> – The results of the radiological analyses of the tridacna clams are given in Tables 28 (Kwajalein) and 39 (Enewetak). The large "killer" clam, <u>Tridacna gigas</u>, and the smaller

clam. Tridacna crocea were the two types collected. All of the clams from JANET, KATE, TILDA, REX, WALT, and LEROY were T. gigas. Clams from ALICE and BELLE were a mixture of the two types of clams, while clams from DAVID, GLENN, HENRY, and Kwajalein were the smaller Tridacna crocea. Although there are known differences in the radionuclide content of a clam, due to age and species, it appeared that collection location was the most important of these three variables. This is probably because most of the clams collected were living during the period of testing and have been accumulating radionuclides for about the same period of time. Where two or more clams of the same species were available from the same area, size was used as a measure of age and the data compared. Although the larger and presumably older clams in some cases had higher radionuclide concentrations, the opposite situation was often true and, on the average, no significant differences were evident. Comparisons between species from the same area were too few to draw any conclusions.

Naturally occurring 40 K was present at normal levels. Samples averaged 10 pCi/g, dry. The most abundant radionuclide accumulated by the tridacna clams was 60 Co. This radionuclide was found in all samples and was present in high concentrations in the kidney samples from most collection areas. Bismuth-207 and 55 Fe were also detected in most samples, but at lower levels than 60 Co. Europium-155 was found at low levels in less than one-third of the samples. Strontium-90 was found in most samples. Americium-241 was detected only in the

						Radion	uclide, average	± standard de	viation ^a in pCi/	g, dry	
	Island	Tissue	No. of samples	No. of clams	⁴⁰ K	⁵⁵ Fe	⁶⁰ Co	155 _{Eu}	207 _{Bi}	90 _{Sr}	239,240 _{Pu}
	ALICE	Mantle and	2	2	10 ± 5.2	3.3 ± 4.5	3.9 ± 0.9	0.08 ± 0.01	0.38 ± 0.01	0.10 ± 0.13	0.05 ± 0.01
		Viscerab	2	2	9.5 ± 0.2	23 ± 11	8.5 ± 0.6	0.69 ± 0.06	3.9 ± 0.6	1.10 ± 0.4	4.7 ± 0.4
		Kidney	1	2	4.9 ± 1.9	68 ± 1.1	460 ± 3	< 0.48	18 ± 0.6	1.1 ± 0.2	0.28 ± 0.04
		Entire	1	1	8.9 ± 1.3	8.3 ± 0.6	34 ± 0.5	0.44 ± 0.10	1.7 ± 0.1	0.62 ± 0.05	1.2 ± 0.1
	BELLE	Mantle and muscle	3	8	11 ± 4	9.7 ± 3.0	18 ± 19	0.15 ± 0.13	0.82 ± 0.36	<0.5	0.24 ± 0.2
		Viscera and kidney	2	7	8.8 ± 4.6	34 ± 3.0	150 ± 72	0.60 ± 0.26	7.9 ± 1.6	1.9 ± 1.7	1.8 ± 0.1
		Viscera	1	۱	55 + 14		12 + 0.2	10 + 01	45 +01		
		Kidney	1	i	$9,5 \pm 3,2$	86 ± 3,2	420 ± 5	< 2.4	20 ± 0.6	0,53 ± 0,10	0.42 + 0.03
	JANET	Mantle and muscle	1	1	14 ± 1.1	7.2 ± 0.1	20 ± 0.4	0.18 ± 0.08	1.6 ± 0.1	0.02 ± 0.01	0.094 ± 0.003
		Mantle	1	1	7 ± 0.8	1.7 ± 0.1	6.4 ± 0.5	< 0.04	0.44 ± 0.04	0.07 ± 0.02	0.06 ± 0.01
		Muscle	1	1	9.4 ± 1.3	0.58 ± 0.03	1.4 ± 0.1	< 0.15	< 0.09	0.26 ± 0.003	_
		Viscera	2	2	9.4 ± 4.8	21 ± 0.4	26 ± 26	1.5 ± 1.2	31 ± 36	0.014 ± 0.007	0.72 ± 0.02
÷		Kidney	2	2	NC ^c	11 ± 0.1	2100 ± 1500	3.7 ± 0.8	64 ± 52	0.28 ± 0.02	0.30 ± 0.01
72		Gills	1	1	7.3 ± 1.2	4.7 ± 0.1	34 ± 0.9	< 0.09	1.4 ± 0.2	0.11 ± 0.01	0.27 ± 0.03
I	KATE	Mantle and muscle	1	1	14 ± 2.8	1.9 ± 0.4	0.5 ± 0.3	< 0.21	< 0.12	0.01 ± 0.003	0.50 ± 0.02
		Mantle	1	1	13 ± 2.5	2.3 ± 0.5	2.4 ± 0.3	< 0.22	· 0.15	0.010 ± 0.003	-
		Muscle	1	1	9.8 ± 1.1	0.83 ± 0.07	2.3 ± 0.1	< 0.05	< 0.04	0,006	0.016 ± 0.005
		Viscera	2	2	5.9 ± 0.6	4.0 ± 0.7	4 ± 4	0.08 ± 0.01	1.7 ± 1.9	< 0.28	0.043 ± 0.003
		Kidney	2	2	6.6 ± 0.9^{cl}	1.0 ± 0.2	280 ± 240	$< 0.53 \pm 0.54$	5.3 + 5.9	0.25 ± 0.04	0.06 ± 0.002
	TILDA	Mantle and muscle	1	1	6.8 ± 1.0	0,97 ± 0,08	1.3 ± 0.1	< 0.05	< 0.05	0.009 ± 0.003	0,49 ± 0,01
		Viscera and kidney	1	1	4.9 ± 1.0	7.2 ± 0.1	19 ± 0.2	0.30 ± 0.05	1.5 ± 0.1	0.27 ± 0.01	2.3 ± 0.1
		Entire	1	1	15 ± 2.0	5.4 ± 0.9	3.4 ± 0.2	< 0.18	< 0.11	2.5 ± 0.2	0.17 ± 0.04
	DAVID	Entire	1	3	15 ± 1.3	< 2.6	7.3 ± 0.3	< 0.14	< 0.09	× 0,7	0.005 ± 0.001
	REX	Mantle and muscle	1	1	11 ± 1.2	-	22 ± 0.5	< 0.52	0.54 ± 0.11	0.013 ± 0.005	0.015 ± 0.001
		Viscera and kidney	1	1	10 ± 2.5	3.0 ± 0.1	780 ± 2	< 0.15	26 ± 0.5	0.018 + 0.002	2.4 ± 0.1
	WALT	Mantle and	1	3	12 ± 1.2	0.70 ± 0.04	2.5 ± 0.2	< 0.10	0.14 ± 0.05	0.018	0.06 ± 0.01
		Viscera	1	3	14 ± 1.3	6 ± 0.5	11 ± 0.2	< 0.13	2.6 ± 0.1	0.10	0.17 ± 0.08
		Kidney	ī	3	17 ± 5.6	22 ± 0.5	420 ± 4	< 0.81	8.0 ± 0.6	0.06 ± 0.04	< 0.16

Table 39. Predominent radionuclides in Tridacna clams collected from Enewetak Atoll, October to December 1972.

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	Kidney	1	3	17 ± 5,6	22	£ 0.5	420 ± 4	< 0.81	8.0 ± 0.6	0.06 ± 0.04	0,16
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GLENN	Mantle and muscle	1	3	1.3 : 0.4	50	: 1.1	7.6 : 0.2	< 0.05	0.38 ± 0.02	0.21	0.016 + 0.663
	Viscera Kidney	1 1	3 3	12 ± 1.3 NC	18	± 1.1 ± 3.0	47 ± 0.8 1250 ± 8	0.76 ± 0.40 3.5 ± 1.1	$\begin{array}{cccc} 10 & \pm 0.2 \\ 33 & \pm 1.9 \end{array}$	0.7	0.28 ± 0.01 0.11
HENRY	Mantle and	2	3	6.8 ± 2.8	5.4	± 0.5	13 ± 9	<0.11 ± 0.05	0.19 ± 0.09	0.02 ± 0.01	0.90 ± 0.02
	Viscera Kidney	2 2	3 3	$\begin{array}{c} 8.6 \pm 1.6 \\ 22 \pm 5^{d} \end{array}$	11	± 0.2	$\begin{array}{rrrr} 43 & \pm 3 \\ 1000 & \pm 540 \end{array}$	$< 0.18 \pm 0.02$ $< 0.93 \pm 0.04$	$\begin{array}{r} 4.8 + 3.7 \\ 20 + 3.5 \end{array}$	· 0,018 0,16 ± 0,05	$\begin{array}{c} 0.28 \pm 0.01 \\ 0.22 \pm 0.01 \end{array}$
LEROY	Mantle and	1	1	13 ± 1.7	4.8	± 0.3	4.5 ± 0.2	< 0.09	6.7 ± 0.6	0.01	0.014 ± 0.001
	Viscera Kidney	1 1	1 1	8.2 ± 1.4 NC	16 68	± 0.3 ± 0.8	$\begin{array}{rrrr} 25 & \pm 0.4 \\ 470 & \pm 3 \end{array}$	NC < 0.56	$\begin{array}{ccc} 1.3 & \pm 0.2 \\ 22 & \pm 0.6 \end{array}$	$\begin{array}{c} 0.053 \pm 0.02 \\ 0.14 \pm 0.02 \end{array}$	$\begin{array}{c} 0.86 \\ 0.18 \\ \pm 0.01 \end{array}$

^aSingle sample error values are one-sigma counting errors, while error values for two or more samples are one sample standard deviation without consideration of counting error.

^b0.79 pCi/g, dry, of ²⁴¹Am was also present in these samples. Americium-241 concentrations of 1.0 and 0.5 pCi/g, dry, were also present in the viscera samples from BELLE and TILDA, respectively.

^CNC = not computed.

^dPotassium-40 was computed for only one of two samples; hence the error is a one-sigma counting error.

viscera samples from ALICE, BELLE, and TILDA, while plutonium-239,240, was detected in most samples. Cobalt-60 concentrations in the kidney samples ranged from 280 to 2100 pCi/g, dry, and averaged 800 pCi/g, dry. The degree of ⁶⁰Co concentration in the other tissues decreased in the following order: viscera (including kidney), viscera (less kidney), mantle, and muscle (Figs. 49 and 50). Cobalt-60 levels were 100 times higher in the kidney than in the mantle and muscle. Viscera concentrations were also much lower than kidney, although not as low as mantle or muscle tissue.

Tridacna collected from the lagoon off JANET had the highest average 60 Co concentration in their kidneys (2100 pCi/g, dry). Kidney samples from Tridacna collected on the seaward reef in the GLENN-HENRY area also had a higher than average 60 Co concentration of about 1100 pCi/g, dry. Other kidney samples averaged 410 pCi/g, dry.

The viscera (including kidney) sample from REX had a very high 60 Co concentration compared to the other viscera plus kidney samples. Considering that most of the 60 Co present in this sample was from the kidney portion, which is about 30% of the sample, the 60 Co concentration in the kidney of this clam, if measured alone, would probably be near that found in the kidney from the JANET clams.

Clams collected at Enewetak Atoll from the reef off DAVID and on the seaward side of TILDA had the lowest concentrations of any of the radionuclides detected in the clams, including ⁶⁰Co. This is undoubtedly due to their constant exposure to relatively uncontaminated ocean water passing over the reef on the east side of the atoll.

Tridacna collected from Kwajalein Atoll had a ⁶⁰Co concentration of 2.3 pCi/ dry, in the viscera plus kidney sample and 0.22 pCi/g, dry, in the mantle plus muscle sample. These levels are below the lowest levels found at Enewetak Atoll

Iron-55 levels were highest in the kidney, ranging up to 86 pCi/g, dry, in the kidney from a Tridacna collected off BELLE. Kidney samples averaged 33 pCi/g, dry. Viscera and mantle plus muscle samples had lower ⁵⁵Fe levels by factors of 3 and 5, respectively.

Bismuth-207 and 155 Eu concentrations were also highest in the kidney samples, but were much lower than 60 Co concentrations. Bismuth-207 in the kidney samples was lower than 60 Co by a factor of about 40, while 155 Eu was lower by a factor of over 600. The highest 207 Bi and 155 Eu concentrations were also found in Tridacna samples from JANET, GLENN, and HENRY, while low levels were found in Tridacna from DAVID and TILDA.

Strontium-90 concentrations were highest in the kidney and viscera, ranging up to 1.9 pCi/g, dry, in a viscera + kidney sample from BELLE. Most tissue sample had concentrations of < 1.0 pCi/g, dry.

Plutonium-239,240 concentrations averaged < 0.5 pCi/g, dry. The maximum value was 4.7 pCi/g, dry, in the viscera of two clams. Viscera plus kidney sample from BELLE and TILDA also had high Pu levels, plus detectable ²⁴¹Am.

<u>Sea Cucumbers</u> – The results of the radiological analyses of the sea cucumbers are given in Table 40. The two genera collected were Actinopygia mauritiana

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				Radi	onuclide, avera	ge i standard	deviation ^a in pC	ig, dry	
Island	Tissue	No. of samples	40 _K	55 _{Fe}	⁶⁰ Co	155 _{Eu}	207 ₁₃₁	90 _{Sr}	$239,240_{\mathrm{Pu}}$
TILDA	E. whole ^b Viscera ^c ,d	2 2	5.4 ± 0.1 1.4 ± 0.1	0.52 ± 0.17	<0.07 0.10 ± 0.02	0.17 ± 0.04 0.32 ± 0.02	< 0.07 - 0.04	$\begin{array}{r} 0.03 \pm 0.03 \\ 1.4 \pm 0.5 \end{array}$	$\begin{array}{r} 0.033 \pm 0.018 \\ 0.56 \pm 0.10 \end{array}$
URSULA	E. whole Viscera	1 1	5.3 ± 1.0 NC ^e	-	~0.08 <0.13	$0.20 \pm 0.04 \\ \le 0.17$	<0.06 <0.07	$\begin{array}{c} 0.03 & \pm 0.01 \\ 0.27 & \pm 0.01 \end{array}$	$0.09 \pm 0.01 \\ 0.044 \pm 0.004$
YVONNE	E, whole Viscera Entire	2 2 1	7.7 ± 1.3 4.3 ± 0.6 3.4 ± 0.85	$\begin{array}{c} 0.35 \pm 0.17 \\ 0.81 \pm 0.56 \\ 2.5 \pm 0.8 \end{array}$	0.29 ± 0.21 0.41 ± 0.26 ≤ 0.18	0.19 ± 0.11 0.53 ± 0.06 0.21 ± 0.07	0.06 ~ 0.08 0.12 ± 0.4	$\begin{array}{c} 0.03 \pm 0.01 \\ 0.15 \pm 0.01 \\ 0.15 \pm 0.01 \\ 0.15 \pm 0.01 \end{array}$	$\begin{array}{c} 0.051\pm 0.55\\ 0.95\pm 0.50\\ 0.28\pm 0.01 \end{array}$
DAVID	E.whole Viscera	1 1	3.6 ± 1.0 NC	0.32 ± 0.05 < 2.0	≤ 0.15 ≤ 0.15	0.37 ± 0.11 > 1.7	$\frac{40.07}{4.1} \pm 1.0$	0.04 ± 0,01 0.16 ± 0,12	0.007 ± 0.001 0.05 ± 0.006
WALT	E, whole	1	6.1 ± 1.3	< 1.7	~ 0.23	0.15	0.09	0.42	0.018
FRED	W.whole Víscera	1 1	7.0 ± 0.77 2.1 ± 0.74	0.28 ± 0.03 0.69 ± 0.19	$< 0.07 \\ < 0.15$	0.16 ± 0.04 0.10 ± 0.04	0.04	0,03 ± 0,01	0.003 + 0.001 - 0.5
GLENN	E. whole Viscera	4 4	5.3 ± 2.2 1.1	6.0 ± 5.2	$6.8 \pm 11 \\ 0.29 \pm 0.13$	0.12 ± 0.03 <0.11 ± 0.06	$1.3 \pm 1.7 \\ 0.54 \pm 0.46$	$0.05 \pm 0.04 \\ 0.20 \pm 0.10$	$\begin{array}{c} 0.74 + 1.2 \\ 0.66 + 1.1 \end{array}$

Table 40. Predominant radionuclides in sea cucumbers collected from Enewetak Atoll, October to December 1972.

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^aSingle sample error values are one-sigma counting errors, while error values for two or more samples are one sample standard deviation without consideration of counting error.

 ^{b}E , whole = eviscenated whole, the outer body covering of the sea cucumber.

^CViscera includes the gut contents, usually coral sand and fragments.

^dThese viscera samples also had an average ²⁴¹ Am concentration of 0.30 pCi/g, dry. One of two viscera samples from YVONNE also had a ²⁴¹ Am concentration of 0.23 pCi/g, dry.

^eNC = not computed.

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Fig. 49. Average 40 K, 55 Fe, 60 Co, and 207 Bi concentration in the kidney of Tridacna clams collected at Enewetak Atoll, October to December, 1972. The 40 K value is the mean of all Tridacna samples.

(2 samples) and Holothuria sp. (11
 samples). Samples of Actinopygia and of
 Holothuria were made up from an average
 pool of 5 and 20 individuals, respectively.
 Naturally occurring ⁴⁰K was the most

abundant radionuclide detected in most of

the sea cucumber samples. It averaged 2.0 and 5.7 pCi/g, dry, in viscera and eviscerated whole sea cucumber samples, respectively. Of the man-produced, radionuclides, 55 Fe and 155 Eu were present in most samples, while 60 Co and 207 Bi were

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detected in some samples. Three of 11 viscera samples had detectable ²⁴¹Am. Plutonium-239, 240 and ⁹⁰Sr were detected in most samples. Iron-55 was present at low levels (< 6.0 pCi/g, dry). Europium-155 was present at low levels (< 0.5 pCi/g, dry) in most samples, with slightly higher levels present in the viscera samples.

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Cobalt-60 and ²⁰⁷Bi were present in only a few samples. The highest ⁶⁰Co levels were in the eviscerated whole samples from GLENN (6.8 pCi/g, dry) and in the viscera samples from YVONNE (0.4 pCi/g, dry). All other samples had ⁶⁰Co levels of less than 0.30 pCi/g, dry. The highest ²⁰⁷Bi levels were in the viscera samples from DAVID (4.1 pCi/g, dry) and in the GLENN samples (eviscerated whole = 1.3 pCi/g, dry; viscera = 0.54 pCi/g, dry). All other samples had ²⁰⁷Bi levels less than 0.12 pCi/g, dry.

Americium-241 was detected in only three samples. The two viscera samples from TILDA had an average 241 Am concentration of 0.30 pCi/g, dry, and one of two viscera samples from YVONNE had 0.23 pCi/g, dry. Plutonium-239,240 was present in the viscera samples at an average concentration of 0.6 pCi/g, dry. The Pu concentration was at least tenfold



Fig. 50a. Average ⁹⁰Sr and ^{239,240}Pu concentration in the viscera, mantle, and muscle of Tridacna clams collected at Enewetak Atoll, October to December, 1972. The ⁴⁰K value is the mean for all Tridacna samples.

lower in the eviscerated whole sea cucumbers. Strontium-90 was highest in the viscera samples from TILDA (1.4 pCi/g, dry), but was less than 0.3 pCi/g, dry in other viscera samples.

<u>Miscellaneous Invertebrates</u> – The results of the radiological analyses of the miscellaneous invertebrate samples are given in Table 41. In the miscellaneous invertebrate category were eight spiny lobsters from YVONNE, nine top snails from LEROY, and six pencil urchins from HENRY. More of these types of samples were not collected because adverse weather conditions (high wind and

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			Radionuclide, average ± standard deviation ^a in pCi/g, dry								
Common name	Island	Tissue	⁴⁰ K	⁵⁵ Fe	⁶⁰ Co	207 _{Bi}	⁹⁰ Sr	239,240 _{Pu}			
Spin y lobster	YVONNE	Muscle Hepatopancreas Exoskeleton	$\begin{array}{cccc} 12 & \pm & 1.2 \\ 6 & \pm & 0.8 \\ 1.8 & \pm & 0.6 \end{array}$	$\begin{array}{c} 0.16 \pm 0.06 \\ 5.3 \pm 0.2 \\ 0.09 \pm 0.04 \end{array}$	0.29 ± 0.14 18 ± 0.3 < 0.14	<0.06 0.16 ± 0.08 <0.05	<0.02 0.013 ± 0.002 0.053 ± 0.01	$\begin{array}{c} 0.006 \pm 0.001 \\ 0.081 \pm 0.004 \\ 0.014 \pm 0.001 \end{array}$			
Pencil urchin	HENRY	Soft parts Hard parts	2.9 ± 0.8 NC ^b	$\begin{array}{ccc} 7.6 & \pm \ 0.4 \\ 1.0 & \pm \ 0.1 \end{array}$	4.6 ± 0.2 < 0.12	0.59 ± 0.06 <0.07	<0.20 ±0.01 0.09 ±0.01	~ 0.022 0.007 ± 0.001			
Top snail	LEROY	Soft parts	7.9 ± 1.0	_	4.8 ± 0.1	6.3 ± 0.1	0.14 ± 0.01	0.02 ± 0.002			

 Table 41. Predominant radionuclides in miscellaneous invertebrates collected from Enewetak Atoll, October to December 1972.

^aSingle sample error values are one-sigma counting errors, while error values for two or more samples are one sample standard. deviation without consideration of counting error.

^bNC = not computed.

waves) during the October to December sampling period made collecting on the seaward edge of the reef, where these organisms live, nearly impossible.

Of the gamma-emitting radionuclides only 40 K. 55 Fe. 60 Co, and 207 Bi were detected in 50% or more of the samples. Potassium-40 was present at background levels. Iron-55 was one abundant manproduced radionuclide detected in the samples. Concentration ranged up to 7.6 pCi/g, dry, in the soft parts of the pencil urchin and 5.3 pCi/g, dry, in the hepatopancreas of the spiny lobster. The highest 60 Co level (18 pCi/g, dry) was also in the hepatopancreas of the spiny lobster. The soft parts of the pencil urchin and the top snail had similar 60 Co concentrations at 4.6 and 4.8 pCi/g, dry, respectively. Comparing all miscellaneous samples for ²⁰⁷Bi, it was found that ²⁰⁷Bi was highest, by a factor of 10, in the soft parts of the top snail with a concentration of 6.3 pCi/g, dry.

The highest 90 Sr concentration was 0.14 pCi/g, dry, in the top snail. All other 90 Sr and Pu concentrations were less than 0.1 pCi/g, dry.

Plankton

Purpose of Collections

Since plankton tend to move with the surface waters and to equilibrate rapidly with them, they can often be used as biological monitors of the radioactivity in their environment. Plankton are also an integral part of the marine food chain, and, because of their ability to very quickly concentrate significant quantities of many radionuclides, they are very useful as indicator species. The radionuclides concentrated by plankton are representative, both in kind and quantity, of those available to other pelagic species of the lagoon.

Sampling and Analysis

All tows were made at the water surface. They varied in duration, but none was less than 15 min or longer than 30 min. Figure 51 shows the site of collectin of each sample. Samples 04119747 and 04120447 were collected with a 1-m, No. 6 (243-micron mesh) net; all other tows were made with a 1-m No. 10 (160micron mesh) net. The collected sample was washed from the net into a glass jar containing formalin.

The samples in formalin were returned to Lawrence Livermore Laboratory (LLL) where they were drained wet and weighed.

Table 42. Enewetak plankton collections - 1972.

Wet wt (g)	Dry wt (g)	Ash wt (g)
27.9	2.77	0.96
6.0	0.66	0.39
15.7	1.48	0.81
8.5	0.94	0.51
33.4	4.34	3.27
27.1	2.91	1.88
17.9	2.01	1.66
11.0	3.17	1.43
13.3	1.28	0.77
6.9	0.84	0.49
23.6	2.33	1.65
23.2	2.05	1.24
28.7	2.88	1,65
9.37	1.56	0.98
18.8	1.82	1.48
16.6	1.68	1.18
	Wet wt (g) 27.9 6.0 15.7 8.5 33.4 27.1 17.9 11.0 13.3 6.9 23.6 23.2 28.7 9.37 18.8 16.6	Wet wt (g)Dry wt (g) 27.9 2.77 6.0 0.66 15.7 1.48 8.5 0.94 33.4 4.34 27.1 2.91 17.9 2.01 11.0 3.17 13.3 1.28 6.9 0.84 23.6 2.33 23.2 2.05 28.7 2.88 9.37 1.56 18.8 1.82 16.6 1.68

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Fig. 51. Location and sample identification of plankton collections at Enewetak Lagoon, 1972.

The samples were dried at 110°C, weighed, ashed at 450°C, and reweighed. Table 42 lists wet, dry, and ash weights of all samples.

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Ash wt (g)

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The gamma-emitting radionuclides in the plankton were identified by gamma spectrometry at LLL. Samples were processed by wet chemical methods for 90 Sr and 239,240 Pu. Only 60 Co, 137 Cs, 155 Eu, 207 Bi, and 241 Am were positively identified by gamma spectrometry, and these were not detected in all 1972 Enewetak plankton collections. The following radionuclides were undetectable in the plankton at the indicated limits of detection: ¹⁰⁶Ru (1.0 pCi/g wet weight); ¹⁰²Rh (0.1 pCi/g); ¹²⁵Sb (0.2 pCi/g); ¹⁵²Eu (0.1 pCi/g); ²³⁵U (0.1 pCi/g).

Table 43 lists the radionuclide concentrations found in the plankton samples. All data are as of time of collection. The mean level of activity of each radionuclide was determined by averaging the 16 values. The most abundant were ⁹⁰Sr and ²⁰⁷Bi followed, in order of decreasing concentration, by ⁶⁰Co, ^{239,240}Pu, ¹⁵⁵Eu, ²⁴¹Am, and ¹³⁷Cs. These, the principal gamma-emitting radionuclides found in the 1972 plankton collections, should be those found in all species that

Sample No.	⁶⁰ Co	¹³⁷ Cs	155 _{Eu}	207 _{Bi}	²⁴¹ Am	^{239,240} Pu	90 _{Sr}
04 069710	1.83	< 0.03	0.06	1.06	< 0.1	0.06	< 0.2
04 091253	< 0.18	<0.12	<0.14	0,21	< 0.3	< 0.05	< 0.8
04 091053	0.27	< 0.06	<0.07	0,20	<0.1	0.04	< 0.3
04 091153	< 0.18	< 0.03	< 0.14	0.22	<0.3	< 0.12	< 2.0
04 069854	0.18	< 0.03	<0.07	0.03	< 0.1	0.16	< 0.2
04 069954	0.09	< 0.03	< 0.07	< 0.03	< 0.1	< 0.02	< 0.4
04 070054	0.27	< 0.05	< 0.07	0.27	< 0.1	0.05	< 0.3
04 114646	1.14	< 0.12	0.22	1.21	< 0.3	0.11	< 0.8
04 114524	< 0.09	< 0.05	< 0.07	< 0.05	< 0.1	0.04	1.98
04 116324	1.01	0.09	< 0.14	1.36	<0.2	0.70	< 0.7
04 116524	1.42	< 0.06	0.66	2.25	0.41	1.69	0.54
04 116247	0.89	0.11	0.62	1.41	0.25	1.31	0.68
04 116447	0.76	< 0.06	0.46	1.45	0.28	0.43	0.24
04 119747	1.33	< 0.11	<0.21	0.83	< 0.3	0.24	2.97
04 11984 7	0.79	< 0.08	0.55	1.62	0.43	0.59	1.05
04 120447	0.50	< 0.05	0.41	0.93	0.25	0.59	0.79
Average ^a	0.68	0.07	0.24	0.83	0.23	0.39	0.86
Average ^b	0.65	0.01	0.19	0.83	0.10	0.37	0.52

Table 43. Radionuclide concentrations in Enewetak marine plankton in pCi/g (wet weight) at time of collection.

^aCounting upper limit values as a real signal.

^bCounting upper limit values as zero.

derive trace elements and radioelements from the pelagic environment of the lagoon.

The plankton proved to be sensitive indicators of the environmental radioactivities in the lagoon. High concentrations of 207 Bi and 60 Co, for example, were found in samples taken near YVONNE and IRENE and from mid-lagoon, while the lowest levels were detected near passes, channels, or reef openings where the atoll is exposed to currents from the open ocean. It is noteworthy that the distributions of some radionuclides in the water coincide with those found for the plankton (see the subsection on lagoon water samples).

It is a useful exercise to compare the present mean activity levels to those found in the 1964 collections. During the 1964 survey of Enewetak (Welander, et al. 1967)^{*} five plankton collections from the lagoon were reported, data for which are shown in Table 44.

Allowing for radioactive decay from August 1964 to December 1972, and Table

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^{*}A. D. Welander, et al., Bikini-Eniwetok Studies, 1964: Part II. Radiobiological Studies, USAEC, Rept. UWFL-93 (Part II) (1967).

Location	⁶⁰ Co	¹²⁵ Sb	¹³⁷ Cs	207 _{Bi}
Enewetak Atoll				
Runit, lagoon side ^a	68	0	0	0
Runit, lagoon side	200	50	0	14
Rigili, lagoon side	130	2.7	0	19
MIKE Crater	58	-	2.2	4.6
Engebi, lagoon side	47	0	0	5.6
Average	100	13	0.44	4.8
		(arith av	sic) 7 8.6

Table 44. Gamma-emitting radionuclides in plankton from Enewetak Atoll, August 1964. Values expressed as picocuries per gram of dry weight at time of collection.

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^aNo. 20 mesh net; all other catches with No. 6 mesh net.

assuming no other processes operating to affect the activity levels in plankton, we should have seen average concentrations of 34 pCi/g (60 Co), 1.5 pCi/g (125 Sb), 0.36 pCi/g (137 Cs), and 7.1 pCi/g (207 Bi). The average dry weight concentrations found in December 1972 were 5.9 pCi/g (60 Co), 0.6 (137 Cs), and 7.3 pCi/g (207 Bi) if upper-limit values in Table 43 are considered positive signals. If the upper-limit values are considered to be zero, as was done by Welander, the average dry weight concentrations found in December 1972 are 5.7 pCi/g (60 Co), 0.09 pCi/g (137 Cs), and 7.3 pCi/g (207 Bi).

Each radionuclide found in plankton was reduced in concentration between 1964 and 1972. The values for ²⁰⁷Bi are about those expected if the loss was due mostly to radioactive decay. The ¹²⁵Sb is below detection limits (~ 2 pCi/g dry) in 1972 collections; its loss could be due mostly to radioactive decay. For 137 Cs and 60 Co, on the other hand, the values for the 1972 collections are significantly less than can be accounted for on the basis of decay alone. Thus, 60 Co and 137 Cs are being lost from the lagoon by removal processes, as well as by physical decay. From the data for 1964 and 1972, it is possible to compute a mean residence half-time, or ecological half-life, for 60 Co and 137 Cs, assuming an exponential loss rate. The equation used to compute the residence time is

$$A_{1972} = A_{1964} e^{-(\tau_1 + \tau_2)t}$$

where τ_1 is the radiological disintegration constant and equals $0.693/t_1$, τ_2 is the environmental loss constant and equals $0.693/t_x$, and t_1 and t_x are the physical and ecological half-lives, respectively. The observed activity levels in the respective years are A_{1972} and A_{1964} . The time, t, is the elasped time between August 1964 and December 1972, or 8.33 yr. In addition to physical decay, 60 Co and 137 Cs are being lost from the lagoon with mean residence half-times of 3.3 and 4.1 yr, respectively.

If the computed mean loss continues at the same rate, the mean 60 Co levels in the water and pelagic biota of the lagoon will be reduced with an effective half-life of approximately 2 yr, and the 137 Cs concentrations will be reduced by one half every 4 yr. The effective half-life for 60 Co deduced from plankton data agrees well with the effective half-life computed from the comparison of fish activity levels in 1964 and 1972.

Comparison of the decreases in activity for 207 Bi with those for 137 Cs and 60 Co indicates clearly that the rate of radionuclide removal, other than by physical decay, is unique for each radionuclide and is controlled by complicated biogeochemical processes occurring within the lagoon environment. In the future, assessments such as the above should be attempted for all long-lived radionuclides, and meaningful sampling programs should be established to verify the predicted losses. Since many processes influence the fate of the radionuclides in each environment phase of the Atoll, the rate of loss of radioactivity may accelerate or decline in the future, depending on the time constants of the controlling mechanisms.

Enewetak Lagoon Sediments

Purposes of Collections

In all, 133 grab samples, 8 dredge samples, and 37 cores providing 127 subsamples were processed. The number of samples was large enough so that, for the first time, we can assess the quantity and distribution of selected radionuclides in the benthic environment of Enewetak Atoll.

This assessment is an integral part of the Enewetak survey; the radionuclides present in sedimentary deposits are potential contaminants of the atoll environment and thus could contribute to the hazard to man. Marine sediments are usually thought of as the ultimate link for quickly sorbed radionuclides, but in reality there are a number of biological and nonbiological paths through which the radionuclides can be recycled into man's food chain. In addition, individuals can be exposed directly to external gamma radiation from some surface-bound radionuclides when shallow areas are used for fishing and/or recreation. Near-shore cores were obtained to provide radiological data for assessment of this exposure route

Sampling Locations

Figure 52 gives the locations of all sediment samples obtained from Eneweral lagoon; Fig. 53 is a separate chart of the area sampled near MIKE and KOA Craters. The entire lagoon was adequated covered, and more detailed coverage was devoted to the area off YVONNE. Duplicate samples were obtained at several locations to determine the degree of variability of radiological data at an individual sampling site.

Sampling locations were predetermine before each day's cruise. Because weather conditions often made it impossible to sample the designated area, especially the western side of the lagoon, alternate cruise plans were usually available as well. Upon reaching the designated location, the vessel was anchored, and sightings were made with a sighting compass on at least two, but usually three or four, fixed landmarks (tips of islands, or recognizable structures). The bearing were replotted on a master chart to local accurately the site of collection of each sample, which was identified with a field number and a sample number.

All position plottings were made on A. M. S. Series W861, Type C (AMS1), 1947 charts of the Marshall Islands prepared under the direction of the Chief of Engineers by the Army Map Service (LUAM), War Department, Washington, D. C.

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Fig. 52. Location and sample identification of sediment samples at Enewetak Lagoon.

D.C. These charts are provided with a 1000-m universal transverse mercator grid: the horizontal control is based on Enewetak Astro Pier, 11°33'28.48" North, 162°21'10.25" East of Greenwich. The average mercator position or grid position of each sample location was determined by triangulation and provided for reference with the output data. All fixes used to provide these reference points are accurate to within 100 m on the AMS Series W861 charts.

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Besides the geographical location, the recorded data usually included the depth of overlying water: Lagoon samples were obtained from depths ranging from 20 to 214 ft.

Thus, the master output of radiological data for marine sediments includes the assigned sample number, the corresponding chart identification number, and the measured depth of water at the sampling location.



Fig. 53. Location and identification of sediment samples at the MIKE and KOA crater area (crater dimensions are not to scale).

Collection Methods and Sample Types

The original purpose of the program was to provide both grab and core samples in sufficient numbers for assessment of both the horizontal and vertical distributions of radionuclides in the lagoon sediments. Coring was attempted with both 8-and 5-cm-diam gravity corers fitted with positive-action closing valves and core catchers. Several of the participants in this marine program had had considerable experience with these devices in near-shore and off-shore areas of the Atlantic and Pacific Oceans, where it was usual to obtain the top 60- to 90-cm section of an undisturbed sediment column. In Enewetak lagoon, however, coring was almost a complete failure. Because of the characteristics of the sedimentary deposits, it was usually impossible to penetrate to depths of more than a few centimeters, even with a weight stand exceeding 80 kg. More often than not, coral or shell fragments entrapped in the core catcher allowed the collected sediment to drain from the liner before the sampler could be retrieved. Several times, the plastic core liners returned to the surface bent at 90 deg angles, attesting to

the presence of numerous coral heads on the lagoon floor. Because of the poor penetration of the corer and the difficulty of retrieving a usable core, it was decided to discontinue the coring attempts and instead to concentrate on grab sampling as the method of collecting sediments. Excellent cores were obtained in both MIKE and KOA craters: here however, the deposit was of uniform consistency and free from shell fragments and coral. Coring was successful also in the near-shore areas. where good visibility permitted positioning of a hand coring device without impaction on submerged objects.

The major objective of defining the levels and distributions of selected radionuclides in the lagoon sediments was realized by analyzing the material collected by the grab samplers. This was not accomplished, however, without difficulties similar to those attending the core sampling. The usual problems were pretriggering of the device on submerged coral knolls and trapping of coral or shells in the closing jaws with resultant loss of collected sediment before the surface was reached. At many locations, the samplers usually had to be lowered several times before an adequate sample was obtained. Field comparisons with the corers showed that the grab samplers not only provided sediment samples of larger surface area but penetrated to equivalant depths in the lagoon floor.

A weighted Ekman grab sampler was used from the Boston Whaler only. It collected a surface sample of 232 cm² surface area and 2.0 cm mean thickness. The penetration depth was uncontrolled on this as well as on the other grab sampler used fro collecte area and Shipek 1 The san of penet 400 cm thicknes The devices tion of t compos tion was percent fragmet areas it sisted c of the s describ servers debris : of the s was det water a of fine. shell fr and For Only determ collect:

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Samp 34B-Gr 35B-Dr 30B-Gr 31B-Dr 29B-Gr 29B-Dr samplers used. A Ponar grab sampler, used from both the Whaler and the LCU, collected a surface sample 523 cm² in area and 2.8 cm in mean thickness. A Shipek grab was used from the LCU only. The sampled area depended on the depth of penetration and varied from 250 to 400 cm² and the mean sediment sample thickness was 4.3 cm.

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The mean depth sampled by all three devices was 3.2 cm (1.25 in.). Penetration of the grab was dependent on the composition of the sediment. Penetration was poorest in areas containing high percentages of coarse sediments, shell fragments, and Halimeda, and deepest in areas in which the bottom sediment consisted of fine-grained material. For 83 of the samples, the composition was described qualitatively by the field observers: 34 contained dead Halimeda debris in amounts ranging from 5 to 85% of the sample. The sediment composition was dependent on location and depth of water and included different percentages of fine, coarse, and dark-grained sands, shell fragments, coral pieces, Halimeda, and Foramenifera debris.

Only levels of radioactivity were determined in the entire sediment sample collection; it was not an objective of this program to assess the quantity of each sedimentary phase or the concentration of radionuclides in each phase.

For comparative purposes, all sediment concentration data is expressed as activity per unit area (mCi/km^2) . Since some samples are diluted in weight with relatively uncontaminated quantities of coral, Halimeda and Forams, this unit better describes the radiological data for relative comparison. There is also evidence that most of the radionuclides are concentrated in the open lagoon sediment surface layers. For example, at several locations, dredge samples were obtained from the anchor of the LCU and provided samples for comparative radiological data with the grab sampler. These two collection methods gave considerably different concentrations of radionuclides per gram, as shown in Table 45. The dredge samples contained less activity per unit weight than the grab samples. This observation supports the idea that radionuclides in those samples from the open lagoon are probably restricted to surface layers of the sediments; the lower activity per unit weight in the dredge samples probably results from sample dilution by relatively uncontaminated subsurface material.

	pCi/g ± % error									
Sample	⁶⁰ Со	⁹⁰ Sr	¹³⁷ Cs	155 _{Eu}	207 _{Bi}	²³⁹ Pu				
34B-Grab	1.83 ± 4	17.1 ± 4	1.02 ± 7	5.98 ± 3	4.5 ± 3	15.7 ± 2				
35B-Dredge	2.53 ± 3	12.7 ± 6	0.81 ± 7	5.88 ± 6	4.4 ± 2	6.2 ± 3				
30B-Grab	1.6 ± 3	15.3 ± 8	1.14 ± 5	7.28 ± 3	4.04 ± 2	14.2 ± 9				
31B-Dredge	1.88 ± 4	7.78 ± 10	0.65 ± 10	3.89 ± 6	2.65 ± 9	7.79 ± 4				
29B-Grab	2.68 ± 2	21.9 ± 10	1.53 ± 4	10.0 ± 4	7.4 ± 2	22.4 ± 9				
29B-Dredge	0.83 ± 7	2.32 ± 17	0.15 ± 27	1.2 ± 7	1.2 ± 5	2.2 ± 5				

Table 45. Grab and dredge sample comparative data for selected radionuclides.

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It should, however, be kept in mind that each grab sample collected penetrated the sediment layer to different depths. The activity per unit area is reported only to the depth sampled. The mean depth sampled by all devices has already been reported as 3.2 cm. Since comparative dredge and grab and/or core data is not available for all areas of the lagoon floor, there may be some areas, especially in the northeast section, where significant levels of activity could be present below the sampling depths indicated.

For each sample, the radionuclide data (in pCi/g) is accompanied by all relevant data including cross-sectional area sampled, thickness or surface layer sampled, and total weight of the sample. With these data, the results can be converted to any unit of activity per unit weight, volume, or area.

Processing (Field and Laboratory)

As each grab or dredge sample was recovered, it was transferred to a polyethylene bag and labeled with a field identification number. At the field laboratory, each sample was double-bagged and labeled with a sample number.

At LLL the volume of each sample was determined, and the penetration depth was calculated from the cross-sectional area of the sampler used. The entire sample was dried at 110°C, ground, and mixed in a ball mill. No attempt was made to separate the sediment into its components. The entire dried sample was weighed and fractions of the sediment were prepared for gamma spectrometry and for radiochemical separation and analysis of ⁹⁰Sr and plutonium radionuclides. The sediments were not analyzed for any other radionuclides than those identified by gamma spectrometry and ⁹⁰Sr and some plutonium radionuclides. Processing was done by members of the Radiochemistry Division, LLL. Gamma spectrometry results were obtained from Ge(Li) detector outputs in both the Bio-Medical and the Radiochemistry Divisions of LLL. Plutonium and ⁹⁰Sr were separated and analyzed by contractor laboratories.

A selected number of samples (listed in Table 46) were analyzed in duplicate at one laboratory for ^{239,240}Pu. It is difficult to assess the accuracy of sets of measurements such as these, but the body of data speaks to the question of sample uniformity. In general, the results are in good agreement, suggesting

Table 46.Plutonium-239,240 analysesof replicate sediment samples

		239,240 _{Pu}
Sam	nlo	(pCi/g, dry)
		± % error
35A	(a)	<0.72 (upper
	(b)	0.13 ± 13
39 A	(a) (b)	0.38 ± 21 0.46 ± 9
7B	(a) (b)	1.09 ± 8 0.94 ± 23
22B	(a) (b)	0.36 ± 9 0.44 ± 10
29B	(a) (b)	2.25 ± 5 2.15 ± 3
1C	(a) (b)	4.78 ± 4 4.78 ± 5
13C	(a) (b)	5.81 ± 6 7.88 ± 24
8D	(a) (b)	0.77 ± 8 0.60 ± 19
19D	(a) (b)	39.2 ± 4 53.2 ± 22

han those metry and lionuclides. ubers of the LL. Gamma stained from the Biotry Divisions were sepator

les (listed duplicate at It is diffisets of but the tion of , the reuggesting

inalyses it samples

39,240_{Pu} Ci/g. dry) : % error 1.72 upper limit) $.13 \pm 13$ $.38 \pm 21$.46 ± 9 .09 ± 8 .94 ± 23 36 ± 9 44 ± 10 25 ± 5 15 ± 3 78 ± 4 78 ± 5 31 ± 6 38 ± 24 7 ± 8 0 ± 19 2 ± 4 2 ± 22

that at least the processing produced uniformly well-mixed samples. The duplicate set of samples address the precision of analysis; in general the results in Table 46 are in satisfactory agreement. The calibration data affecting the accuracy of the results is discussed in detail in the Analysis Program section of this report.

Cores collected from the craters and near-shore areas were identified by numbers in the field. At the field laboratory, the cores were logged in and stored in an upright freezer chest. The frozen cores were returned to LLL, where they were sectioned in known depth increments and processed by the same procedure used for the grab samples.

Analysis and Results

Lagoon Sediment — The radionuclides identified in some, but not necessarily all, processed sediments from the lagoon include 238 Pu, 239,240 Pu, 90 Sr, 137 Cs, 241 Am, 155 Eu, 60 Co, 152 Eu, 154 Eu, 102m Rh, 207 Bi, 125 Sb, 101 Rh, and 106 Ru. In some samples the natural potassium radioisotope, 40 K, and daughter products of the uranium decay series were detected by gamma spectrometry.

The identification of gamma-emitting radionuclides in any sample was dependent on sample size, detector characteristics including background, and the sample counting time. Because of these variables, the lowest limit of positive detection of any gamma-emitting radionuclide was necessarily different for each sample analyzed. Americium-241 was positively identified by spectrometry in marine sediments when the level of activity generally exceeded 3 mCi/km^2 or, approximately, 0.1 pCi/g. Examples of other averaged lower limits are 1 mCi/ km^2 for ²⁰⁷Bi; 1.5 mCi/km² for ¹⁵⁵Eu; 2 mCi/km^2 for ⁶⁰Co; 1 mCi/km² for 137 Cs; 0.5 mCi/km² for 152 Eu; and 1 mCi/km^2 for 102mRh. Ruthenium-106 was positively identified by spectrometry in only three samples. The levels of activity were all less than 1.3 pCi/g. For all practical purposes, therefore, gamma-emitting fission products with half-lives less than 1 yr and fission yields comparable to ¹⁰⁶Ru should no longer be detectable in the lagoon environment. Ruthenium-106 was measured in surface sediments collected from MIKE Crater during the 1964 survey. * The average ¹⁰⁶Ru concentration reported was 100 pCi/g (range - 29-170 pCi/g). By 1972 this level has decayed to an average of 0.6 pCi/g. Three 1972 surface sediments from MIKE Crater were found to contain less than 0.5 pCi/g of 106 Ru. This assessment is additional verification that this radionuclide is nearly depleted from the marine environment. The radionuclides. 54 Mn and 57 Co. also reported in marine samples collected during the 1964 survey, were not detected in any 1972 sediment collection.

Europium-154 was identified in only seven bottom sediment samples. The computed mean value of 154 Eu found in the seven samples was 0.5 ± 0.6 pCi/g. Four of the samples were from KOA Crater and the remaining samples were

^{*}A. D. Welander, <u>et al.</u>, <u>Bikini-</u> <u>Eniwetok Studies</u>, 1964: Part II. Radio-<u>biological Studies</u>, USAEC, Rept. UWFL-93 (Part II) (1967).

from stations 33A, 24B, and 23B. The three lagoon stations are located in the northeast sector of the lagoon, 1 to 5 km from KOA Crater.

For all other radionuclides identified in the sediments, the deposited activity levels determined at each station were plotted on lagoon charts. Isopleths were constructed and the resulting distributions of 90 Sr, 239,240 Pu, 137 Cs, 60 Co, 102m Rh, 241 Am, 207 Bi, 155 Eu, 152 Eu, 125 Sb, and 101 Rh in the lagoon sediments are shown in Figs. 54 to 64.

The activity levels in the cross hatched area of each figure were, for the most part, below detection limits. It was impossible to construct isopleths in this region of the lagoon because of the scatter in the data points. Therefore, deposition upper limits were determined for this region and are shown in the boxes enclosed in each figure. Some mean values of the activities in the cross hatched region were computed and are also shown in the enclosed box.

Each radionuclide is nonuniformly distributed over the lagoon floor. The most contaminated area of the lagoon can be roughly separated from a relatively uncontaminated area by an imaginary line extending from the Southwest Passage to the island of TOM on the eastern rim of the Atoll. The sediments in the region north of this line are much more burdened with fission and activation products than the area south of this division. Cobalt-60, ²⁰⁷Bi, ^{102m}Rh. and ¹⁵²Eu. all activation products, are most intense in deposits off the shore of the IRENE-JANET area, while 137 Cs, 90 Sr, 155 Eu, ²⁴¹Am. and ^{239,240}Pu are most concentrated in north-south oriented elliptical

areas, roughly 2 to 3 km east of the islands of ALICE and BELLE. The high. est concentration of 125 Sb is found in sediments a few kilometers south of this area. The sediment burdens decrease in a southwesterly direction from the northwest towards the center of the lagoon. A secondary region of contamination, but with significantly lower activity levels than the northwest region, is noted off the shore of YVONNE. The offshore distribution of relatively high activity sediment in this area is restricted to a smaller region than found in the northwest. The concentration levels decrease in all directions from YVONNE but appear to decrease more rapidly toward the south and north than toward the center of the lagoon. Isolated pockets of relatively high concentration levels of some radionuclides are evident in otherwise lesser contaminated areas of the lagoon,

The mean lagoon sediment activity per unit area of each radionuclide was determined from Figs. 54 to 64. These results are tabulated in Table 47 and ranked in order of decreasing mean activity. The most abundant radionuclide detected was 90 Sr, followed by 239,240 Pu, 155 Eu, 241 Am, 207 Bi, 137 Cs, 60 Co, 125 Sb, 102m Rh, 152 Eu, 101 Rh, 154 Eu, and 106 Ru.

The percent of the lagoon floor containing radionuclides at or above several levels of activity was determined from Figs. 54 to 64. This data is tabulated in Table 48. Approximately 15% to 20% of the area of the lagoon contains 90 Sr, 239,240 Pu, 155 Eu, 241 Am, and 125 Sb at concentrations which exceed their respective computed mean level. Only 11% of the area of the lagoon is contaminated



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Fig. 56. Activity levels of ¹³⁷Cs deposited in the sediments of Enewetak Lagoon.



Fig. 57. Activity levels of ⁶⁰Co deposited in the sediments of Enewetak Lagoon.













igoon.



Activity levels of ¹⁰¹Rh deposited in the sediments of Enewetak Lagoon. Fig. 64.

sediment	S.
	Activity/unit area
Radionuclide	(mCi/km ²)
⁹⁰ Sr	586
^{239,240} Pu	463
155_{Eu}	369
²⁴¹ Am	172
²⁰⁷ Bi	163
¹³⁷ Cs	78
⁶⁰ Co	73
¹²⁵ Sb	22
$102m_{Rh}$	8.4
¹⁵² Eu	2.5
¹⁰¹ Rh	1.2

1 able 47.	tions in Er sediments.	newetak Lagoon
		Activity/unit area
Radionucli	de	(mCi/km ²)

with 137 Cs at a level which exceeds the mean value of 78 mCi/km² while 20 to 25% of the lagoon floor contains $^{207}\mathrm{Bi}$, 60 Co, and 102m Rh at levels which exceed their mean level of activity. The activation products appear more widespread in Enewetak sediments than either the transuranics or detected fission products.

For comparative purposes, a few selected radionuclide concentrations found in aquatic sediments elsewhere in the world are shown Table 49. Only values for a few of the radionuclides present in Enewetak are available for comparison but it is immediately apparent from the data in Table 49 that Enewetak sediments

Concentra-											
tion level (mC1/km ²)	90 _{Sr}	²³⁹ Pu	¹⁵⁵ Eu	^{24 l} Am	²⁰⁷ Bi	¹³⁷ Cs	⁶⁰ Co	¹²⁵ Sb	102m _{Rh}	152 _{Eu}	¹⁰¹ Rh
14000	0	0.01	0	0	0	0	0	0	0	0	0
10000	0.4		0	0	0	0	0	0	0	0	0
9000	<u> </u>	-	0	0.2	0	0	0υ	0	0	0	0
8000		0.7	0		0	0	0	0	0	0	0
7000	2.1	—	0	_	0	0	0	0	0	0	0
6000	_		0	-	0.2	0	0	0	0	0	0
5000	_	—	1.0			0	0	0	0	0	0
4000	_		_			0	0	0	0	0	0
3000	4.9	2.9	—	—		0	0	0	0	0	0
2000			—	1.3	-	0.3	0.3	0	0	0	0
1000	11.6	8.5	7.8	2.5	1.7	1.3	0.6	0	0	0	0
500	16.5	14.1	15.6	5,6	2.5	4.3	1.9	0.7	0	0	0
400	_	14.3		—	-		-	_	0	0	0
300		—		_	—				0	0	0
200		33.9			_	_	_	2.5	0	0	0
100	40.3	47.9	32.9	20.5	27.4		12.6	6.0	0.5	0	0
50	56.3	59.7	47.7	34.2	49.1	12.1	31.9	6.3	2.7	0.6	0
20	_	—	65.5	51,1		—		_		2.4	0
10	~100	-		59.5		26.1	70.5	1.85	20.0	_	2.7
5	~100	~100	-	>90		38.8	_	32.1	35.5	7.8	10.7
1	~100	~100	~98		100	>60	~98	_		23.5	17.4

Table 48. Percentage of lagoon bottom area burdened with radionuclides above several levels of activity.

^aLagoon area = 932 km^2 .

^bValue not computed.

contain substantially higher deposits of artificially produced radionuclides than any other geographic area for which we have data.

MIKE and KOA Crater Sediments — The locations of the sediment samples collected from the area of MIKE and KOA Craters are shown in Fig. 53. Results of analyses for the gamma-emitting radionuclides, 90 Sr, and plutonium radionuclides in the surface grab samples are presented in Table 50. Shown also in Table 50 are the mean values and standard deviations for the radionuclides in both craters; the mean surface concentrations in MIKE and KOA Craters; and the mean concentrations at the three sampling water-depth intervals: (a) greater than 90 ft, (b) from depths greater than 4 ft but less than 90 ft, and (c) from surface sediments around the rim of the craters (samples 25E to 31E). The mean sediment thickness of the crater grab samples was 6.0 cm. Concentrations of the radionuclides in the crater surface sediments are extremely variable. With the exception of 207 Bi, there are higher concentrations of all radionuclides in MIKE Crater surface sediments than are found in KOA Crater deposits.

There appears to be a correlation between sediment radionuclide content and sampling depth. The surface sediments from the deeper depths within the craters

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Radionuclide	Collection date	Location	mCi/km²
239,240 _{Pu}	1968-1970-71	Buzzards Bay, Mass.	2.3 + 0.1
^{239,240} Pu	1971	Lake Ontario	0.6 + 0.2
^{239,240} Pu	1968	Bylot Sound, Greenland	3 9
239,240 _{Pu}	1968	Bylot Sound, Greenland	135
⁹⁰ Sr	1970-71	Buzzards Bay, Mass.	0.6 + 0.
	1969	Lake Superior	4 4
	1966	Lake Michigan	3.7
	1966	Ligurian Sea	3.0
137 Cs	1970-71	Buzzards Bay, Mass.	7.6
	1973	Humboldt Bay, Calif.	21
	1969	Lake Superior	155
	1971	Lake Ontario	14
⁶⁰ Co	1963	11 km off mouth of Columbia River, USA	64
	19 7 3	Humboldt Bay, Calif.	3.5
¹⁵⁵ Eu	1966	Ligurian Sea	18

Table 49. Some selected radionuclide data in aquatic sediments.

contain higher levels of radionuclides than do sediments from shallower and surface deposits. In the past, any extreme turbulence or large scale mixing of the sediments should have produced a much more uniform distribution of radionuclides than that presently observed. The crater bottom sediments are, therefore, probably not subjected to severe scouring or resuspension, and the principle loss of activity from the deposits may only be from the slow release to the overlying waters and diffusion upward where the activities then mix with the surface waters and are diluted by advective processes. Since 1964, the concentration levels of several radionuclides in the

crater sediments have not diminished at rates substantially faster than predicted by radioactive decay alone. In Table 51 are the mean concentrations of 60 Co, 125 Sb, 137 Cs, and 207 Bi in the crater sediments from both the 1964 and 1972 survey. The value of each 1964 radionuclide detected, when decay corrected, agrees with the value found in the 1972 samples.

Roughly the same ordering of the principal radionuclides is found in the crater deposits as were found in the lagoon sediments. Strontium-90 is the most abundant radionuclide in the surface layers, followed by, in order of decreasing concentration, 239,240 Pu, 155 Eu, 241 Am,

Am, ng coniyers, abunon sedithe princted, 1972 radionu-^able 51 ⁰Co, rater 1 1972 edicted ished at 0.6±0.1 4.4 mCi/km2 64 3.5 2.3 ± 0.2 0.6 ± 0.2 3.9 155 14 18 13521 7.6 3.0 3.7

Table 50. Radionuclides in the surface sediments of MIKE and KOA Craters.

		Water		Radionuclide / oncentration (pt.). g/												
No.	tion	depth (ft)	⁶⁰ Co	90 _{Sr}	101 _{Rh}	102m Rh	125 _{Sb}	137 _{C5}	152 _{Eu}	Eu		Pa	21-11-1	TALX		
35C	MIKE	90	14.5 ± 1.7	82.4 ± 4.7	0.82 ± 7.5	3.09 ± 5.0	1.79 ± 17	18.2 ± 1.9	0.62 ± 21	47.5 : 3.9	2.45 : 9,7	67,1 : 8,4	3,03 : 17	23.5 + 45.3		
34C	MIKE	65	1.98 ± 2.2	35.4 ± 4.2	N. R. ^b	0.14 ± 19	0.30 ± 24	7.89 ± 1.3	0.13 ± 24	6.8±4	0.36 ± 11	32.1 ± 16	1.08 ± 100	-3.61 ± 1.5		
38C	MIKE	61	2.86 ± 1.4	43.5 ± 4.2	0.19 ± 7	0.82 ± 4	0.56 ± 11	9,90 ± 1.7	0.21 ± 13	28.4 ± 2	1.3 ± 3	47.3 ± 8	1.67 1 13	15,4 в		
33C	MIKE	92	8.61 ± 1.2	55 ± 5	0.45 ± 5	2.03 ± 4	1.40 ± 12	12.5 ± 1	0.35 ± 25	$28,8 \pm 3$	2.71 ± 2	49.1 ± 6	2.36 ± 10	12.1 ± 11		
32C	Junction MIKE and KOA	91	12.0 t 1.0	52.3 ± 5	0.60 ± 3	2.22 ± 2	2.03 ± 4	10.4 ± 2	0.28 ± 19	30.3 ± 2	2.75 ± 2	37.5 ± 3	$2,49 \pm 17$	10.2 ± 6		
36C	KOA	102	1.61 ± 5	27.5 ± 4	0.09 ± 22	0.53 ± 10	0.64 ± 31	2.24 ± 4	<0.09	9,20 ± 4	1.77 ± 6	12.0 ± 2	$4,21 \pm 12$	3.37 ± 18		
31C	KOA	112	8.68 t 3	42.8 ± 4	0.50 + 8	2.22 t 3	1.54 ± 10	6.41 ± 2	0.20 ± 18	30,6 ± 6	6.69 ± 2	37.7 ± 7	$5,49 \pm 9$	7,03 ± 35		
37C	KOA	60	1.04 t 7	13.4 ± 5	0.07 + 12	0.29 ± 7	0.23 ± 20	1,62 1 2	0,14 ± 19	6 ,1 ± 3	0.92 ± 3	$7,66 \pm 8$	$1,04 \pm 13$	$1,66 \pm 12$		
29C	KOA	110	7.89 ± 2	45.1±3	0.41 ± 6	1,73 ± 3	1.44 ± 7	5,96 ± 2	0,36 ± 18	23.5 ± 3	$5,62 \pm 1$	3,35 1 7	0.56 ± 7	4.78 ± 14		
mear	i, all samp	des	6.5 ± 4.6	44 1 19	0.4 ± 0.3	1,5 / 1,0	$1, 1 \pm 0.7$	8,3 + 5,1	0.3 + 0.4	र्स ३ मि	2.7 3 2.1	33.3.24	2, 1 + 1, 5	9,7 1.6,7		
mean,	MIKE Cr	ater	8.0 ± 5.5	54 ± 18	0,5 ± 0,3	1.7 ± 1.1	1,2 ± 0,8	11.8 + 3.9	0.3 ± 0.1	28 ± 14	1.9 ± 1.1	47 ± 13	$2,1 \pm 0,8$	14.0 1.6.1		
mean	, KOA Cra	iter	6.2 ± 4.8	36 ± 16	0,3 ± 0,2	1.4 ± 0.9	1.2 ± 0.7	5,3±3,6	0.2 ± 0.1	20 ± 12	3.6 t 2.5	20 t 17	2.2 ± 2.0	5,4 ± 3,3		
mean, a	ll samples	>90 ft	8,9 ± 4,4	51 ± 18	0.5 ± 0.2	2.0 ± 0.8	1.5 ± 0.5	9.3±5.6	0.3 ± 0.2	28 ± 12	3.7 t 2.0	34 ± 24	2.5 ± 1.7	10.2 ± 7.4		
mean, a	ll samples	<90 ft	2.0 ± 0.9	31 ± 16	$0, 1 \pm 0, 1$	0.4 ± 0.4	0.4 ± 0.2	6.5 ± 4.3	0.2 ± 0.0	14 ± 13	0.9 ± 0.5	30 F 30	$1, 3 \pm 0, 4$	$8, 6 \pm 6, 3$		
mean, al around	l surface : i craters (sediment 0-6 cm)	s 1.0 ± 0.9		N. R.	0.1 ± 0.1	0.3 ± 0.3	4.7 ± 6.1	0.2 ± 0.2	4.7 ± 2.9	0.5 ± 0.3			10.4 ± 10.		

^aError expressed in % of value given.

^bN.R.-not reported.

Date of	Water	Croter				
sampling	ft	location	⁶⁰ Co	¹²⁵ Sb	¹³⁷ Cs	207 _{Bi}
7/64	~90	MIKE	29 ± 17	11 ± 7	12 ± 7	5.9 + 4 -
D ecay cor	rected to 1	Dec. 1972	9.7 ± 5.7	1.3 ± 0.8	9.9 ± 5.8	4.9 + 3 -
12/72	all	MIKE	7.1 ± 4.9	0.9 ± 0.6	11.6 ± 3.8	1.9 + 1 1
12/72	>90	MIKE and KOA	7.9 ± 3.9	1.2 ± 0.4	9.1 ± 5.5	3.6 ± 20
12/72	>90	MIKE	10.3 ± 3.7	1.3 ± 0.2	15.0 ± 3.9	2.5 ± 0.2

Table 51. Comparison of the concentrations of several radionuclides in MIKE Crater sediment, 1964 to 1972.

 137 Cs, 60 Co, 207 Bi, 238 Pu, 102m Rh, 125 Sb, 101 Ru, and 152 Eu. Bismuth-207, more abundant than 137 Cs and 60 Co in the open lagoon, is less abundant in the surface layers of the crater sediments.

The radionuclide concentrations in subsections of 4 cores obtained from the craters are shown in Table 52. With the exception of 207 Bi and 152 Eu, all other radionuclides are found distributed the length of the sediment column sampled. The levels of ⁶⁰Co, ^{102m}Rh, ¹²⁵Sb, and ¹³⁷Cs, in general, increase down the sediment column. 241 Am and 155 Eu concentrations, although variable near the surface, only slowly decrease in value down the sediment column. The sediment profiles of ²⁰⁷Bi are shown in Fig. 65. For comparison, 60 Co, 137 Cs, ²⁴¹Am, and ¹⁵⁵Eu concentrations in core 15E are plotted as a function of depth in Fig. 66. The different vertical distribution patterns are obvious, probably indicative of differential movement of one radionuclide relative to another. Unlike the other radionuclides, ²⁰⁷Bi is not detected below depths of 30 to 40 cm in the sediment column. There also appears to be a discontinuity in the con-

centration profiles of ²⁴¹Am. ¹³⁷Cs. 155 Eu, and 60 Co at the 30- to 35-cm level in the core. These and other observations to be discussed indicate that the sediment surface layers in MIKE and KOA Craters are possibly ejecta from other nuclear events held in the Atoll. Holmes and Narver profiled the postevent depths of MIKE Crater in 1952 and found the maximum crater depth to be near 180 ft below sea level, During 1964, the Holmes and Narver survey indicated the bottom depth of MIKE Crater was then at 90 ft below sea level. Between 1952 and 1964, there was either considerable slippage of the crater slopes to fill in the crater bottom or tests held after 1952. such as KOA or others, contributed fill to the crater area. Clearly natural sedimentation can be ruled out since between the years 1964 to 1972, a period of no testing, there has been no measurable change in the bottom depth of the crater. Presently, at least 30 to 40 cm of sediment, richer in ²⁰⁷Bi, covers a ²⁰⁷Bi depleted sediment region in both craters. Rhodium radionuclides, ¹⁰¹Rh and 102m Rh, are also found in the crater sediments. In sample 15E of the mean

mean ater <u>11</u> craters. f sedi-207_{Bi} crater. rable of no between ral sedied fill 1952, n the ble slip-952 and s then at ited the 64, the near nd found oostevent Atoll. and that the er obser. -cm 7_{Cs}, from 2.5 ± 0.2 3.6 ± 2.0 4.9 ± 3.7 1.9 ± 1.1 5.9 207 Bi ± +.5

E Crater

	Depth incre-						a					
Core No,	ment (cm)	60 _{Co}	102mRh	101 _{Rh}	125 _{Sb}	137 _{Cs}	152 Eu	155 _{Eu}	207 Bi	²⁴¹ Am	215 Pu	ic
17E(92 ft)												
05789247	0-5	10.8 ± 3	2.4 ± 6	0.59 ± 9	2.4 ± 14	13.1 ± 2	0.3 ± 70	42.9 ± 2	3,17 ± 4	20.1 ± 8	51.4 ± 13	56.3 ± 12
7893	5-10	11.3 ± 2	2.8 ± 5	0.68 ± 10	2.1 ± 16	13.5 ± 2	0.5 ± 30	46.6 ± 2	4.65 ± 3	19,6 ± 8	50.5 ± 10	73,4 ± 8
7894	10-15	27.1 ± 1	4,3 ± 3	0.98 ± 6	8.1 ± 4	16.4 f 1	0.4 ± 30	63.0 ± 2	11.4 ± 1	22,4 ± 8	60.8 ± 6	91.4 ± 7
7895	15-20	47.3 t 1	5.7 1 4	1.45±5	16.9 ± 3	18,6 ± 2	0.5 ± 27	60.4 ± 3	8,3 ± 3	16.4 ± 11	56.3 ± 4	112.2 ± 5
7896	20-25	53.7 ± 1	5.4 1 4	1.41 ± 4	16.4 ± 3	17.2 ± 2	$0, 1 \pm 100$	54,3±2	2.5 ± 7	14.1 ± 5	51.4 ± 3	117.1 ± 6
7897	25-30	59.4 ± 1	5.8 ± 2	1.60 ± 3	22.6 ± 2	17.9 ± 2	0.3 ± 28	54.7 ± 1	1.6 ± 8	12.2 ± 4	47.3 ± 4	159 ± 7
7893	30-35	55.5 ± 2	5, 1 + 4	1.48 t 5	25.8 ± 3	15.9 ± 3	0.2 ± 100	46.0 ± 1	0.7 ± 20	10,4 : 5	$40,9 \pm 6$	104 ± 10
7899	35-40	83.8 ± 2	7.0 ± 5	1,95 + 7	27.9 ± 4	24.0 ± 3	0.4 ± 100	59,6 t 3	0.3 + 100	12.2 ± 13	47,8 1.5	126 1 8
7900	40-45	83.5 ± 1	7.0 ± 5	1,90 ± 7	29.1 ± 4	23.9 ± 4	0.4 ± 100	61.2 ± 2	0.3 ± 100	$13,6 \pm 10$	45.5 ± 6	132-т Б
7901	45-50	88.9 ± 2	7.1 ± 5	1.99 ± 8	29.2 ± 4	24.5 ± 1	0.4 ± 100	59.4 ± 2	0.3 ± 100	13.7 ± 11	45.5 ± 6	146 ± 7
7902	50-56	71.3 ± 2	6.3 ± 10	1.77 ± 12	19.5 ± 8	20.0 t 6	0.6 ± 100	47.8 : 4	0.5 ± 100	12.6 ± 21	91.4 ± 44	113 ± 9
16E(91 ft)											6 . G . C	16 6 1 10
05790347	0-5	1.2 ± 100	3.4 ± 11	0.77 ± 14	3.9 ± 18	14.3 ± 5	<0.4	40.4 1 4	4.45 ± 9	15.3 ± 17	34.6 ± 6	49.6 ± 16
7904	5-10	60.7 ± 3	7.2 ± 11	1.91 ± 17	15.2 ± 11	20.1 ± 6	<0.7	57.6 t 4	4.93 ± 14	16.1 ± 18	51.4 ± 8	60.4 ± 9
7905	10-15	62.1 ± 2	6.3 ± 9	1.72 ± 14	19.7 ± 8	19.4 ± 5	<0.7	49,5 : 6	0.5 ± 100	12.7 t 25	46.4 ± 8	88,7 ± 10
7906	15-20	54.3 ± 2	4.5 ± 10	1.25 ± 16	20.1 ± 8	19.6 ± 5	<0.6	44.9 t 5	1.6 ± 25	11,3 ± 25	39.8±8	93.7 ± 9
7907	20-25	68.3 ± 2	6.2 ± 9	1.54 ± 13	22.9 ± 7	21.0 ± 5	<0.7	49,4 : 6	0.5 ± 100	10.7 : 25	42.0 ± 10	81.9 ± 11
7908	25-30	64.1 ± 3	5.5 ± 9	1.63 ± 14	25.2 ± 6	20.6 ± 5	<0.6	46. 3 ± 6	0.5 ± 100	8.9 ± 25	40.2 ± 5	131 ± 6
7909	30-38	64.2 ± 1	5.7 ± 9	1.61 ± 10	22.4 ± 6	20.8 ± 4	<0.6	45.1 ± 6	0.4 ± 100	7,9 ± 26	44.3 ± 5	106 ± 6
14E(110 ft)	1											
05788347	0 - 5	7.2 ± 2	1.7 ± 5	0.42 + 7	1.5 ± 14	5.72 ± 3	0.27 ± 30	28.1 ± 1	5,28 4 2	5,59 £ 6	25,6 1 6	31.5 ± 11
7884	5-10	8.2 ± 9	2.1 ± 7	0.52 t 8	2.0 ± 16	$6,46 \pm 4$	$0,48 \pm 31$	34.9 ± 1	6,924.5	6,13 ± 6	43.3 + 2	42.1 4 1
7885	10-15	11.7 ± 3	2.6 ± 7	0.62 t 10	3.9 ± 10	6.71 t 4	0.1 ± 100	37.0 ± 1	10.7 ± 4	6.31 ± 6	53.9 ± 2	45.6 ± 1.0
7886	15-25	25.4 ± 2	3.3 ± 7	0.79 t 14	10.7 ± 7	7.08 ± 5	0.4 ± 100	38.3 1 6	12.5 ± 5	8,46 1 27	5 1,8 i 3	59.9 ± 4
7887	25-35	44.7 ± 2	4.816	1.23 ± 11	15,5±5	9,44 ± 4	0.4 t 100	35.4 1 6	3.35 ± 9	6,73 1 28	36,1 1 2	49,5 1 5
7888	35-39	50.4 ± 2	5.7 ± 7	1.49 ± 12	17.6 ± 7	11.6 ± 5	0.5 ± 100	38.8 t 6	1.14 ± 25	6,11 t 28	44.2 t 2	73.9 ± 6
15E(112 ft)											
05791047	0-5	13.5 ± 5	2.5 ± 23	0.47 ± 34	4.21 ± 26	7.14 ± 7	0.5 ± 100	40.5 ± 7	10.5 : 7	8,7 ± 29	36.4 ± 4	58.6 ± 7
7911	5-10	34.5 ± 1	5.2 ± 5	1.14 ± 7	16.8 ± 3	8,50 ± 5	0.2 ± 100	62.6 ± 5	23.4 ± 2	$8,9 \pm 12$	50.0 ± 4	75.2 ± 6
7912	10-15	42.4 ± 2	4.6 ± 7	1.04 ± 11	15.2 ± 5	10.5 ± 6	0.3 ± 100	45.9 ± 3	6,7 ± 8	8.3 ± 12	37.1 ± 8	27.2 ± 12
7913	15-20	46.7 ± 1	4.5 ± 4	1.14 ± 6	15.4 t 4	10.9 ± 3	0.37 ± 70	36,8 ± 3	1.7 ± ''	7.2 ± 10	28.6 ± 7	78.4 18
7914	20-25	49.6 ± 2	4.6 ± 4	1.27 ± 6	20.0 ± 3	11.6 ± 3	0.37 ± 70	37.7 ± 3	1.7 ; '	7.5 ± 10	28.9 ± 2	
7915	25-30	44.9 ± 2	4.5 ± 6	1.06 ± 10	15.6 ± 5	10.9 ± 4	0.3 ± 100	35.2 ± 3	1.3 ± 15	7.5 ± 11	27,5 ± 3	88.7 ± 8
7916	30-35	46.5 ± 4	5.1 ± 12	1.30 ± 18	13.9 ± 10	11,0 ± 9	0.5 ± 100	29.6±5	0.4 ± 100	5.7 ± 22	28.5 ± 3	
7917	35-40	47.8 ± 3	5.2 ± 10	1.29 ± 16	19.5 ± 9	12.7 ± 7	0.6 ± 100	32,7 ± 5	0.5 ± 100	7.6 ± 22		81,5 1 5
7918	40-45	47.1 ± 1	4.4 ± 4	1.29 ± 5	17.5 ± 3	11,9 ± 3	0.2 ± 100	37.3 ± 3	0.61 ± 18	6.9 ± 12	30,1 ± 3	79.7 ± 7
7919	45-50	48.2 ± 1	4.8 t 5	1.34 ± 8	20.0 ± 3	12.8 ± 3	0.2 ± 100	39.9 ± 2	2.2 ± 8	7.1 ± 22	29 .4 ± 3	154 : 4
7920	50-55	47.6 ± 1	5.0 ± 6	1.34 ± 5	18.3 ± 3	11.5 ± 3	0.1 ± 100	38,2 ± 1	1.12 ± 14	5.5 ± 16	29.5 ± 4	151 ± 3
7921	55-63	46.9 ± 2	4.5 ± 6	1.32 ± 8	17.6 ± 5	10.5 ± 4	0.2 ± 100	32.2 ± 2	0.2 ± 100	5.3 ± 10	33.6 ± 4	197 ± 2

Table 52. Radionuclide concentrations in core samples from the crater.

^aError expressed in % of quoted value.



Fig. 65. Profiles of the ²⁰⁷Bi concentration in crater cores.

ratio of the two rhodium radionuclides, to the maximum depth sampled, is 0.253 ± 0.032 . The ratios in samples 17E, 14E, and 16E are, respectively, 0.265 ± 0.019 , 0.249 ± 0.009 , and 0.267 ± 0.024 . To within one standard deviation, these values are identical and are distinct from ratios of 0.12 to 0.17 found in some open lagoon sediments. It would be extremely coincidental if 101Rh and 102mRh were produced in both the MIKE and KOA Events, separated in time by 6 yr, in quantities which today yield identical ratios. Rather, the results suggest a single source for the rhodium isotopes

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now found in the sediments of bc ters. The origin of the differen zons of the surface crater sedim unknown, but are probably eject other events held in the northwe of the Atoll. Rhodium isotopic r identical in value to those found and KOA craters are detected in from JANET, IRENE, DAISY, ar while quite different and distinct are found in soils from ALICE a BELLE.

<u>Near-Shore Sediments</u>—The concentrations of the principal g emitting radionuclides in near-s iments are tabulated in Table 53 sediment cores were obtained fr surf-zone in no more than 3 ft o ing water. Highest levels of act found in samples from IRENE, I and the sand bars surrounding M KOA craters. The areal distrib activity is similar to that found shore sediments.

Surprisingly there appears to difference in the radionuclide co tion of lagoon and ocean near-sh ments. This observation again : that the bottom lagoon sediments subjected to large-scale resuspe and subsequent redistribution wi lagoon. These latter mechanisn necessarily act as driving force: duce significantly higher concent of radionuclides in the near-sho deposits relative to the ocean-si sediments.

In Situ Probe Survey—An in gamma-spectrometry survey of goon bottom off YVONNE, ELMI

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Fig. 66. Selected radionuclide concentration distributions in core 17E-KOA crater.

FRED was made during December, 1972. This survey was conducted to obtain data for the comparison of the results of field measurements with the results of the more sophisticated and time-consuming laboratory analyses of water and sediments. If the field measurements were acceptable, areas of high gamma activity in the lagoon sediments could be identified and the sampling program could be immediately adjusted in accordance with the findings. The gamma probe was built at the Laboratory of Radiation Ecology, University of Washington, and is a modification of an in situ probe originally designed by Gordon Riel of the United States Naval Ordnance Laboratory, White Oak, Maryland. The probe is composed of a 3 in. \times 3 in. sodium iodide crystal, a photomultiplier, and a preamplifier, all encased in a brass waterproof housing.

Power was supplied by a pair of 12-V batteries, and the signal cables were connected to a 200-channel analyzer with video display and tape printout subunits, all of which were carried on the AEC 24-ft launch. The probe was capable of operating to depths of 300 ft and of withstanding the shocks associated with its use aboard ships.

Prior to making a probe reading, the boat was anchored and its position determined by taking bearings on known landmarks. The probe was then lowered on a hand-held steel cable to the bottom of the lagoon and a 10- to 20-min count was taken and recorded on paper tape. Using a pipe dredge, a sediment sample was taken from as near to the <u>in situ</u> probe location as was possible. After the count was completed, the probe was raised to just below the water's surface and the

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		Mean dry	Length	pCi/g ^a dry			
Island – location	Chart No.	(g/cm ³)	of core (cm)	⁶⁰ Co	¹³⁷ Cs	207 _{Bi}	155 _{Eu}
FRED – lagoon	(missing), marine pier		15	<0.04	<0.04	0.09 ± 0.03	<0.07
FRED – ocean	38E	$\textbf{1.22} \pm \textbf{0.04}$	15	<0.04	<0.03	0.55 ± 0.15	0.18 ± 0.10
FRED – ocean	37 E	1.38 ± 0.35	15	<0.04	<0.03	<0.04	0.07 ± 0.04
WALT - lagoon w/end	11E	1.55 ± 0.08	15	<0.02	<0.02	<0.02	<0.05
WALT - lagoon e/end	12E	1.16 ± 0.03	15	<0.03	<0.02	<0.02	0.07 ± 0.04
YVONNE – lagoon	32E	1.49 ± 0.02	14	0.67 ± 0.49	<0.06	0.36 ± 0.07 .	0.71 ± 0.22
YVONNE - lagoon s/end	33 E	1.31 ± 0.11	15	<0.03	<0.01	0.06 ± 0.03	0.09 ± 0.03
YVONNE — lagoon s/end	34E	1.50 ± 0.08	15	<0.03	<0.02	0.11 ± 0.06	0.11 ± 0.06
YVONNE – oc eans ide s/end	35E	1.40 ± 0.05	15	0.05 ± 0.05	<0.02	0.03 ± 0.03	0.15 ± 0.04
YVONNE - oceanside s/end	36E	1.24 ± 0.22	15	<0.03	< 0.01	< 0.01	0.15 ± 0.03
URSULA – lagoon s/tip	8E	1.06 ± 0.07	15	<0.06	<0.04	<0.02	0.63 ± 0.29
URSULA – lagoon (center of island)	39E	1.08 ± 0.21	14	<0.04	<0.03	<0.02	0.32 ± 0.16
URSULA – oceanside	42E	0.97 ± 0.11	15	<0.02	0.10 ± 0.04	<0.02	0.20 ± 0.07
TILDA – lagoon e/tip	7 E	1.08 ± 0.08	16	0.18 ± 0.15	0.21 ± 0.04	<0.03	0.63 ± 0.05
JANET - lagoon se/end	9E	1.14	15	0.26 ± 0.08	0.64 ± 0.20	0,17 ± 0,10	1.01 ± 0.20
JANET – lagoon nw/end	10E	1.11	16	0.10 ± 0.04	<0.3	0.47 ± 0.20	1.46 ± 0.51
IRENE - Seminole crater area	40E	1.23 ± 0.06	15	4.73 ± 0.74	1.23 ± 0.25	0.25 ± 0.05	2.48 ± 0.43
HELEN - lagoon w/tip	41E	1.13 ± 0.19	12	0.84 ± 0.10	1.19 ± 0.49	1.02 ± 0.23	4.14 ± 1.24
HELEN - lagoon sand bar	25E	1.19 ± 0.05	12	0.46 ± 0.15	0.12 ± 0.03	<0.04	1.15 ± 0.11
HELEN - lagoon s/tip	26E	1.30 ± 0.07	17	0.60 ± 0.23	0.47 ± 0.19	0.23 ± 0.05	3.12 ± 0.73
HELEN - n/end	27 E	1.16 ± 0.03	12	0.66 ± 0.12	0.59 ± 0.16	0.74 ± 0.07	2.26 ± 0.48
Sand bars around MIKE	28E	1.20 ± 0.09	12	0.79 ± 0.22	4.72 ± 2.35	0.62 ± 0.20	4.55 ± 2.03
and KOA Craters	29E	1.36 ± 0.02	12	1.02 ± 0.25	5.12 ± 0.34	4.80 ± 1.01	0.54 ± 0.08
	30E	1.21 ± 0.05	17	1.29 ± 0.17	6.21 ± 1.61	0.45 ± 0.09	5.64 t 0.71
	31E	1.06 ± 0.14	13	2.32 ± 0.70	10.4 ± 10.1	0.89 ± 0.08	6,58 ± 3,57
BELLE – lagoon e/end	6E	1.07 ± 0.09	15	0.24 ± 0.04	0.39 ± 0.21	0.17 ± 0.04	1.42 ± 0.21
BELLE — lagoon w/end	5E	1.18 ± 0.15	14	0.39 ± 0.34	0.54 ± 0.22	0.11 ± 0.06	2.06 ± 1.22
LEROY - n/end	4 E	1.15	23	0.03 ± 0.03	<0.02	0.29 ± 0.06	<0.03
HENRY - w/end	3E	1.16	17	< 0.05	<0.03	0.13 ± 0.04	<0.08
GLENN – lagoon	2E	1.12	20	<0.04	<0.02	0.26 ± 0.18	<0.07
GLENN – oceanside	1 E	1.12	10	<0.03	<0.02	0.18 ± 0.11	<0.04

Table 53. Concentration levels of principal gamma emitting radionuclides in nearshore sediments.

<0.03 <0.08 <0.07 <0.04 COTE. The ling in the second second 0.26 ± 0.18 0.29 ± 0.06 0.13 ± 0.04 0.18 ± 0.11 <0.03 <0.02 <0.02 <0.02 10 1011 -----U.U.2 2 U.U.S
 4D
 1.10
 23
 0.03 ± 0.03

 3E
 1.16
 17
 < 0.05</td>

 2E
 1.12
 20
 < 0.04</td>

 1F
 1.12
 20
 < 0.03</td>

 and standard deviation obtained by averaging each
 < 0.03</td>
^aCalculated mean value GLENN - oceanside GLENN - lagoon HENRY - w/end nun lui - Vourre

boat was moved to the next station. The probe remained in the water during a day's operation in order to maintain the detector at a near-constant temperature and thus prevent a shift in the gain component of the analyzer (a change in "gain" affects the identification of the radionuchde).

Sixty-seven probe readings were made in 6 days in the lagoon off YVONNE and six readings were made in the lagoon off ELMER and FRED. Station locations off YVONNE and the depths at each station are shown in Figs. 67 and 68, respectively.

Near YVONNE, gamma peaks of 40 K, 60 Co, 137 Cs, and 207 Bi could be readily identified from the video display and the tape printout of the probe data. However. only ⁴⁰K and ²⁰⁷Bi were readily detected off FRED and ELMER. Since ²⁰⁷Bi and 60 Co were detected at most stations off YVONNE, relative concentrations of these radionucludes were determined for the probe readings taken there. The relative concentration of 60 Co was calculated from its 1.33-MeV photon by summing the values from the five channels closest to the 1.33-MeV channel. Relative concentrations of ²⁰⁷Bi were determined by summing the 1.06-MeV peak channel, one channel below the peak, and the two channels above the peak, and subtracting the value of the sum of the two channels (four total) on each side of the four channels summed for 207 Bi. The results of the relative concentration calculations, standardized to 1-min counts, are shown in Figs. 69 (60 Co) and 70 $(^{207}_{Bi})$

These results indicated that 60 Co conrentrations were greatest when the probe was on the bottom at a depth of 60 to 75 ft in an area bounded on the south by a line parallel to the personnel pier and on the north by a line perpendicular to HARDTACK Bunker No. 1610. Bismuth-207 concentrations were also high in this area, but the highest ²⁰⁷Bi levels occurred at a depth of 60 to 70 ft in an area 600 m offshore of craters at the north end of the island. Near-shore ²⁰⁷Bi levels were high in an area ranging north from just off CACTUS Crater. Cesium-137 concentrations were also high in this area.

Whereas ⁶⁰Co showed steadily increasing concentrations out to a depth of 75 ft, ²⁰⁷Bi concentrations were at low (3.5 to 9.9 relative counts per minute) and moderate (10 to 29 relative counts per minute) levels near the shore, with a band of nonsignificant readings (relative count < background count) at intermediate depths (20 to 50 ft) followed by moderate and high levels at greater depths. Potassium-40 levels were relatively constant throughout the survey area.

The sediment samples which were taken simultaneously with the in situ probe readings were prepared and analyzed in the same manner as discussed in the section on lagoon sediments. Results of these analyses are shown in Figs. 71 (⁶⁰Co), 72 (²⁰⁷Bi), 73 (¹⁵⁵Eu), 74 (^{241}Am) , 75 $(^{239,240}Pu)$, and 76 (^{238}Pu) . Americium=241/^{239,240}Pu ratios found in the sediment samples are plotted in Fig. 77, while 238 Pu/ 239,240 Pu ratios are plotted in Fig. 78. Potassium-40, ^{102m}Rh. ¹²⁵Sb. ¹³⁷Cs, and ¹⁵²Eu were detected in more than 50% of the samples; 154 Eu. 226 Ra, and 235 U in 15 to 40% of the samples; and 101 Rh, 106 Ru, 134 Cs. and ¹⁴⁴Ce were detected in an occasional



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Fig. 67. Station locations for in situ gamma probe reading and sediment samples taken in the lagoon of YVONNE, Enewetak Atoll, December, 1972.



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Depth in feet at in situ probe stations in the lagoon off YVONNE, Enewetak Atoll, December, 1972. Fig. 68.







Fig. 70. Relative ²⁰⁷Bi concentrations in cpm, measured with an <u>in situ</u> gamma probe on the lagoon bottom off YVONNE, Enewetak Atoll, December, 1972.

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Fig. 71. Cobalt-60 concentration (pCi/g, dry) in sediment samples taken simultaneously with <u>in situ</u> probe readings in the lagoon off YVONNE, Enewetak Atoll, December, 1972.

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Fig. 72. Bismuth-207 concentration (pCi/g, dry) in sediment samples taken simultaneously with in situ probe readings in the lagoon off YVONNE, Enewetak Atoll, December, 1972.



Europium-155 concentration (pCi/g, dry) in sediment samples taken simultaneously with in situ probe readings in the lagoon off YVONNE, Enewetak Atoll, December, 1972. Fig. 73.

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Americium-241 concentration (pCi/g, dry) in sediment samples taken simultaneously with in situ probe readings Fig. 74. in the lagoon off YVONNE, Enewetak Atoll, December, 1972.





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Fig. 76. Plutonium-238 concentration (pCi/g, dry) in sediment samples taken simultaneously with in situ probe readings in the lagoon off YVONNE, Enewetak Atoll, December, 1972.

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Scale: 1 cm = approx 60 m





sample. Radionuclides other than 40 K, 60 Co, and 207 Bi were generally present at levels less than 1 pCi/g, dry.

It can be seen by comparing Figs. 69 and 71 and Figs. 70 and 72 that a good correlation exists between the degree of ⁶⁰Co and ²⁰⁷Bi contamination indicated by the relative counts and the actual 60 Co and 207_{Bi} concentration measured in the sediment samples. A rough estimate of the concentration of 60 Co and 207 Bi in sediments, in terms of pCi/g, dry, can be obtained at stations where the gross relative count is greater than background by dividing the net relative count by a factor of 85 for 60 Co and 15 for 207 Bi. Factors ranged from 38 (Station 3) to 290 (Station 38) for 60 Co and from 7 (Station 74) to 72 (Station 35) for 207 Bi. These ranges are not surprising, since the sediments analyzed were surface samples taken within 10 ft of the in situ probe at shallow stations and within 30 ft at deep stations during counting, not at the exact location of the probe.

There are no direct comparisons available between ¹⁵⁵Eu, ²⁴¹Am, and Pu levels in the sediments and in the in situ readings since the NaI crystal and associated components used in the survey were not capable of detecting these isotopes. The distribution (Figs. 73 to 76) of these radionuclides does, however, correlate fairly well with the distribution of 207 Bi, which can be measured with the in situ probe. In general, ¹⁵⁵Eu, ²⁴¹Am. and 239,240 Pu concentrations are high in the sediments from three areas: (1) the shallow near-shore area off CACTUS Crater, (2) the shallow near-shore area from HARDTACK Bunker 1310, northeast along the shore for 400 m and (3) in an area offshore, from the personnel pier HARDTACK Bunker 242, at a depth of to 70 ft. The highest concentration of 241 Am was found in a sediment sample taken from shallow water off the center of the northern part of the island, while the highest 155 Eu concentration was found in sediment from a deep-water (62 ft) station, 600 m off the same area of the island.

In summary, the highest levels of the radionuclides detected in the lagoon sed ments off YVONNE with the in situ probe and in sediment samples analyzed in the laboratory are found in an area 500 to 700 m offshore at a depth of 60 to 70 ft. Good correlation between the relative counts obtained with the in situ probe and the concentration of 60 Co and 207 Bi four in sediment samples taken simultaneous with the probe readings indicates that the in situ gamma probe can be used effectively to delineate relative levels (i.e., relative to the actual amount of radionuclide present, not relative to other isotopes) of contamination in the lagoon basin.

Lagoon Water Samples

Purpose of Collections

These samples were taken to assess the present concentrations and distribution of specific radionuclides in the lagoon and craters. From the water and biota data, it will be possible to compute the "concentration factors" of specific radionuclides in marine species, an index which will be useful in models designed to predict future levels of activities in pelagic species. in an Pier to h of 60 n of mple enter while as ter area

of the n sedi-1 probe in the 0 to 70 ft. tive obe and 3i found ineously that the effec-(i.e.. dionur isoon

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Fig. 79. Location and identification of 55-liter water samples. The depth of the water sampled is shown in parenthesis.

Sampling Locations and Collection Methods

Figure 79 indicates the location and depth of all water samples collected at Enewetak Atoll during October to December 1972. At those locations where more than one sample was obtained, the deepest was collected within 1 to 2 m of the bottom. All samples were pumped without filtering into 55-liter "Deldrum" containers, acidified to pH 1.5 with HCL, and shipped to LLL for processing.

Processing and Analysis

A known quantity of carrier or tracer for each radionuclide to be measured was added to the sample. Cesium was first removed by coprecipitation on ammonium molybdophosphate (AMP) and ¹³⁷Cs determined on a low-level gamma spectrometer. Strontium, the lanthanides, the transuranics, and transition metals were then precipitated with sodium carbonate. After dissolution of the carbonate, a hydroxide precipitation separated all the lanthanides, transuranics, and transition metals from strontium (and calcium). Plutonium radionuclides were isolated from the hydroxide fraction and determined by alpha spectrometry, the residual fraction was concentrated and counted on a Ge(Li) diode for gamma emitters, and the ⁹⁰Sr fraction was sent to a participating laboratory for further analysis.

Many of the gamma-emitting radionuclides found in the marine sediments were not detected in the water samples by gamma spectrometry. The following radionuclides were below detection limits in all samples: 102mRh < 80 fCi/liter; 125 Sb < 220 fCi/liter; 106 Ru < 580 fCi/ liter; 152 Eu < 104 fCi/liter; 235 U < 70 fCi/liter. Fifteen samples from the northern half of the lagoon did contain

detectable amounts of ⁶⁰Co, ¹⁵⁵Eu. 207 Bi, and 241 Am (see Table 54). In no other samples were these nuclides above their detection limits.

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¹³⁷Cs and ^{239,240}Pu, radiochemically separated and analyzed by more sensiti analytical techniques, were positively identified and determined in all samples. Greater sensitivity for the other radionu. clides could have been realized in this way, but it was not economically justifiable. The cesium and plutonium results are listed in Table 55. Table 56 gives the mean surface water concentrations of ¹³⁷Cs and ²³⁹Pu in the four quadrants of the lagoon and in the ocean close to the east side of the Atoll. The difference in concentrations between the lagoon and ocean clearly indicates the Atoll to be the

·	Concentration, fCi/liter ± % error						
Sample No.	⁶⁰ Со	155 _{Eu}	²⁰⁷ Bi	²⁴¹ Am			
103	116 ± 35		<224				
112	146 ± 67		<53				
114	518 ± 29						
123	$354~\pm~16$	1433 ± 5	$420~\pm~21$	346 ± 15			
124	<68		734 ± 10				
126	<67		$261~\pm~16$				
129	<40		570 ± 10				
365	842 ± 8	940 ± 7	1266 ± 9	314 ± 18			
366	121 ± 33		258 ± 23				
368	138 ± 22		204 ± 22				
373	$136~\pm~38$		<88				
374	118 ± 34		<242				
377	<51		413 ± 42				
383	<50	67 ± 50	683 ± 10	36 ± 50			
386	<61		154 ± 26				
Detection limits (average)	75	100	80	100			

Gamma-emitting radionuclides identified in separated hydroxide fraction of Table 54. water samples.

Eu,). In no es above hemically sensitive tively ∃amples. radionuin this justifi-1 results gives ations of rants of to the rence in n and to be the action of ²⁴¹Am 346 ± 15 314 ± 18 36 ± 50

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Table 55. Radiocesium and plutonium in seawater samples.

Sample No.	Ac	tivity, fCi kg	± 1σ	Patio		Watar	Watan danth f	
(see Fig. 79)	-137 _{Cs}	239,240 _{Pu}	²³⁸ Pu	239/137	238 239	Bottom	Sample	
	206 ± 10	6.0 + 1.1	1 1 + 0 2	0.020	0 192	a	·	
79	290 ± 10	325 ± 30	2.7 ± 0.5	0.020	0,100	26	ა ი	
80	471 ± 22	51.6 ± 3.0	2.7 ± 0.3	0.009	0.005	30	ა იე	
81	3200 ± 21	34.0 ± 3.0	1.3 ± 0.4	0.020	0.035	90	93	
82	730 ± 20	23.4 ± 2.0	2.0 ± 0.4	0.002	0.000	95	ა ე	
103	480 ± 17	40.0 ± 1.4	0.0 ± 0.3	0.090	0.136	60 a	ა ე	
104	241 ± 10	15.1 ± 0.7	1.9 ± 0.2	0.054	0,145	a	ۍ ۱۳۵	
105	300 ± 19	17.4 ± 0.7	2.5 ± 0.2	0.058	0.144	— a	150	
106	342 ± 19	22.4 ± 0.7	2.2 ± 0.1	0.065	0.098		3	
107	190 ± 14	9.6 ± 0.5	0.9 ± 0.1	0.051	0.094	100	95	
108	229 ± 16	10.2 ± 0.5	1.1 ± 0.2	0,045	0.108	20	3	
109	228 ± 17	9.6 ± 0.5	1.0 ± 0.1	0.042	0.104	70	3	
110	377 ± 18	28.9 ± 0.9	3.8 ± 0.2	0.077	0.131	>100	3	
111	258 ± 20	11.6 ± 0.4	1.4 ± 0.9	0.045	0.121	<u> </u>	3	
112	163 ± 19	15.4 ± 0.7	1.9 ± 0.2	0.094	0.123	22	3	
113	$170~\pm~18$	4.8 ± 0.3	0.6 ± 0.1	0,028	0.125	80	3	
114	462 ± 17	51.9 ± 1.9	7.1 ± 0.4	0.112	0.137	100	3	
116	32 ± 19	0.43 ± 0.25	0.01 ± 0.01	0.013	0.023	a	3	
117	107 ± 30	11.8 ± 0.9	1.7 ± 0.2	0.110	0.144	34	3	
118	$1100~\pm~17$	26.4 ± 1.4	3.2 ± 0.3	0.024	0.121	110	50	
119	$290~\pm~17$	18.0 ± 0.9	2.3 ± 0.2	0.062	0.128	48	3	
120	228 ± 14	7.4 ± 0.6	1.1 ± 0.1	0.032	0.149	<u> </u>	3	
121	$251~\pm~22$	2.8 ± 0.7	0.14 ± 0.05	0.011	0.050	93	90	
123	8910 ± 40	$1510~\pm~60$	236 ± 9	0.169	0.156	110	108	
124	579 ± 18	71.2 ± 2.3	10.0 ± 0.5	0.123	0.140	190	3	
125	59 ± 9	6.8 ± 1.0	1.6 ± 0.2	0.115	0.235	40	3	
126	322 ± 18	30.4 ± 1.2	3.9 ± 0.3	0.094	0.128	197	3	
127	1170 ± 19	19.0 ± 0.8	1.7 ± 0.2	0.016	0.089	110	3	
128	532 ± 25	33.1 ± 1.5	3.0 ± 0.3	0.062	0.091	35	3	
129	538 ± 20	44.4 ± 1.7	4.4 ± 0.3	0.083	0.099	175	3	
365	427 ± 21	3780 ± 210	1280 ± 70	8.852	0.338	197	195	
366	499 ± 28	77.0 ± 3.1	13.3 ± 0.8	0.154	0 173	171	3	
367	482 ± 25	66.2 ± 3.0	7.9 ± 0.6	0 137	0 119	175	े २	
368	410 ± 23	96.1 ± 3.7	14.9 ± 0.8	0.234	0.155	114	่ ว	
371	305 ± 20	75.2 ± 3.1	11.2 ± 0.7	0.247	0 149	114	111	
373	4220 ± 40	71.9 ± 5.8	7.0 ± 1.0	0.017	0.097	<u>95</u>	46	
374	462 ± 22	63.2 ± 2.8	9.0 ± 0.6	0 137	0 149	175	175	
375	305 + 23	29.0 ± 1.0	37 + 0.4	0.005	0 199	110	511	
		20.0 ÷ 1.1	0 + 0.1	0.030	0.120	30	ა	

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Sample							
No. (see	Ac	tivity, fCi/kg	<u>= 1</u> σ	Ra	tio	Water d	lepth.
Fig. 79)	¹³⁷ Cs	239,240 _{Pu}	²³⁸ Pu	239/137	2387239	Bottom	Sample
376	250 ± 20	18.6 ± 1.2	2.6 ± 0.3	0.074	0.140	54	3
377	364 ± 21	62.9 ± 2.7	9.7 ± 0.7	0.173	0.154	6	3
378	497 ± 25	43.1 ± 1.4	7.1 ± 0.3	0.087	0.165	171	167
379	246 ± 19	14.5 ± 0.7	2.1 ± 0.2	0.059	0.145	100	3
381	176 ± 19	6.8 ± 0.5	0.7 ± 0.1	0.039	0.103	70	3
382	$766~\pm~30$	54.3 ± 2.2	4.0 ± 0.3	0,071	0.074	30	3
383	295 ± 25	53.3 ± 2.0	4.6 ± 0.3	0.181	0.086	190	182
384 '	146 ± 26	0.21 ± 0.04	0 ± 0.05	0.001			3
385	130 ± 20	1.60 ± 0.14	0.5 ± 0.1	0.012	0.312	65	3
386	291 ± 30	13.9 ± 0.6	2.0 ± 0.2	0.048	0.144	40	3
387	109 ± 32	0.38 ± 0.10	0.03 ± 0.01	0.003	0.079	30	3
611	970 ± 40	1330 ± 70	411 ± 22	1.37	0.31		
612	212 ± 35	302 ± 4	65 ± 2	1.42	0.22		
613	118 ± 62	57 ± 3	26 ± 2	0.48	0.46		
614	935 ± 46	185 ± 7	98 ± 3	0.197	0.53		
615	108 ± 54	46 ± 2	24 ± 2	0.426	0.52		
616	302 ± 57	105 ± 9	52 ± 5	0.347	0.50		

Table 55 (continued).

^aBottom depth not determined.

Table 56. Concentration of ¹³⁷Cs and ²³⁹Pu in comparative, surface water samples.

Table 57. Comparison of radionuclide concentrations in surface and bottom water samples from Enewetak Lagoon.

			Enewetak Lagoon.				
Location	Concentration, fCi/liter 137		Sample No. (Surface sample)	Ratio 127			
Location		P u	(Bottom sample)	^{239,240} Pu	¹³ 'Cs		
Enewetak Lagoon			194				
SE quadrant	226	9.1	$\frac{124}{383}$	1.33	1.96		
NE quadrant	334	42.6	366				
NW quadrant	579	33.4	378	1.78	1.00		
SW quadrant	332	21.6	367	1.05	1 04		
Ocean, east of Enewetak Atoll	89	0.3	374	1.00	1.01		
Lake Michigan (1971)	88	1.1	$\frac{368}{371}$	1.27	1.34		
Humboldt Bay, Calif. (1973)	300		571				
14°N 180°W (1972)	143	0.44	$\frac{106}{105}$	1.29	1.14		
12°N 170°E (1972)	170	0.35	111				
Windscale vicinity (1969)	105,000		107	1,20	1,36		
Mean surface, Atlantic 0-31°N (1968)		0.7	Mean ± std dev	1.32 ± 0.24	1.31 ± 0.35		

source of the radionuclides in the lagoon rater. For comparison, the concentrations of these nuclides from several other locations in the world are also presented. It is interesting that while the highest plutonium concentrations in water are found in the northeast quadrant, the highrst concentrations in the sediments are found in the northwest.

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Table 57 gives the surface-to-bottom concentration ratios of ^{137}Cs and $^{239,240}Pu$ at six lagoon stations. (Sample 365 is suspected to be contaminated with bottom sediment and is not included in Table 57.) The surface waters, on the average, contain 30% more ^{239}Pu and ^{137}Cs than the bottom waters. The higher surface-to-bottom ratio indicates that during the sampling period, the water in the lagoon was not well mixed vertically. Furthermore, the finding of the considerably lower concentrations in the bottom waters contradicts the prediction that the sediments are the principal source of radionuclides found in the lagoon water. If they were, leaching or resuspension processes would be expected to concentrate radionuclides in the bottom relative to the surface waters. The higher concentrations at the surface may be caused, in part, by leaching processes or surface runoff from the exposed reef areas.

Table 58 gives the water concentrations of 137 Cs and 239,240 Pu in the five craters on the Atoll. The concentration

		. 137~		239 240_			
Table 58.	Concentrations	of Cs	and	- Pu in	crater	water	samples.

	Crater and		Collection	fCi/liter ± 15		
Sample No.	location	Depth	date	239,240 _{Pu}	¹³⁷ Cs	
82	MIKE (center)	Surface	12/12/72	23.4 ± 2.0	730 ± 20	
373	MIKE (center)	46 ft	12/12/72	71.9 ± 5.8	4220 ± 40	
81	MIKE (center)	93 ft	12/12/72	54.6 ± 3.8	3200 ± 21	
127	KOA (center)	Surface	12/11/72	19.0 ± 0.8	1170 ± 19	
118		50 ft	12/11/72	26.4 ± 1.4	$1100~\pm~17$	
123		108 ft	12/11/72	$1510~\pm~60$	$8910~\pm~40$	
611	SEMINOLE (south edge)	Surface	12/15/72	1330 ± 70	970 ± 40	
614	CACTUS (windward—east)	Surface	2/8/73	185 ± 7	935 ± 46	
616	CACTUS (leeward—west)	Surface	2/8/73	105 ± 9	302 ± 57	
615	LA CROSSE (windward—east)	Surface	2/8/73	46 ± 2	108 ± 54	
613	LA CROSSE (leewardwest)	Surface	2/8/73	57 ± 3	118 ± 62	
Background	East of Atoll	Surface	12/9/72	0.32 ± 0.15	89 ± 80	

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levels in the bottom waters of both MIKE and KOA Craters are higher than the surface, and, surprisingly, the middepth sample from MIKE Crater contains more ¹³⁷Cs and ^{239,240}Pu than the bottom sample. The latter observation suggests that there may be localized concentrations of fine particulates resuspended in the water above the bottom of the crater.

Water samples from the leeward and windward sides of CACTUS Crater contain more plutonium and cesium than samples from LA CROSSE Crater. The plutonium-238/239 values in the water samples from both CACTUS and LA CROSSE are similar to but larger than the values found in any other lagoon water sample. Note also that the concentrations of 137 Cs and 239 Pu in the water from both sides of LA CROSSE Crater are similar in value, while there is a definite difference between the two sides of CACTUS Crater.

To put in proper perspective the concentrations of the radionuclides measured in the lagoon water, a comparison with the natural concentration of 40 K is useful. 40 K in seawater is, on the average, 2.95 $\times 10^5$ fCi/liter, a concentration several orders of magnitude higher than that for any fission or activation product measured in any Atoll water sample in this survey.

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TERRESTRIAL BIOTA SURVEY

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The Terrestrial Biota Survey had as its objective the collection and analysis of all available terrestrial vegetation and animal species which could be used as a basis for estimating population doses through dietary pathways. Not all vegetable and animal components of the anticipated Enewetakese diet are currently available on the Atoll; of those that are, not all are available on every island. Sampling was carried out on an asavailable basis and extrapolations were made when required. This chapter describes the sampling and analytical portions of the Terrestrial Biota Survey; dose estimates and extrapolations are discussed in the Dose Assessment chapter.

Ecological Description of Islands on Enewetak Atoll

A general description of each island on the Atoll is given to provide an ecological background to the biota survey. A more comprehensive description of Enewetak Atoll ecology may be found in other publications (e.g., Woodbury, 1962)^{*}. Color photographs of each island are presented on the "a" series, vegetation sampling locations are shown on the "g" series, and animal and bird sampling locations are shown on the "p" series of figures in Appendix II.

ALICE (Bogallua)

ALICE is covered with a dense to scattered growth of the two common trees on the Atoll: Messerschmidia argentea and Scaevola frutescens.* These, plus another woody plant, Guettarda speciosa, were collected. The typical beach association of plant species was found in open areas, such as the southwest end of the island, and was composed of Ipomoea pes-caprae, Fimbristylis atollensis, Triumfetta procumbens, and Lepturus repens. An introduced grass, Cynodon dactylon, was also present in sandy disturbed areas. probably the result of man's previous activities on the island. At the southwest and northeast ends of the island. the low scrub growth of Messerschmidia and <u>Scaevola</u> opens up and the vegetation assumes a more scattered appearance. especially at the southwest end, where a sedge-grass meadow prevails. Vegetation is rather dense on the entire seaward side of the island.

Animal species encountered at the time of collections (January 8, 1973) were the long-tailed tropicbird, noddy terns, and fairy terns, which were all nesting. A soil sample was collected from a 12×12 -in. area to a depth of 2 in.

BELLE (Bogombogo)

Vegetation of Bogombogo Island consists of a dense scrubby growth of

A. M. Woodbury, <u>A Review of the</u> <u>Ecology of Enewetak Atoll, Pacific</u> <u>Ocean.</u> University of Utah, Institute of Environmental Biological Research, (1962).

Plant taxonomy according to H. St. John, "Flora of Enewetak Atoll," <u>Pacific</u> <u>Science 14</u>, 313 (1960).

<u>Messerschmidia argentea</u> and <u>Scaevola</u> <u>frutescens</u>. This growth thins at the northeast end of the island where an open scattered growth of these tree species occurs. The ground in this open area is vegetated by the usual complex of disturbed-area beach or strand species described on Bogallua Island. Other woody species which contributed only a small amount to the vegetative cover of Bogombogo Island were <u>Guettarda</u> <u>speciosa</u> and a species of <u>Pandanus</u>. The Pandanus plant was bearing fruit and a collection was made.

Soil on this island was coral sand with a small amount of organic matter in it.

CLARA (Ruchi)

Vegetation of Ruchi Island is mainly a scattered growth of <u>Messerschmidia</u> <u>argentea</u> and <u>Scaevola frutescens</u>. The vegetation pattern is more open than on Bogallua or Bogombogo Island to the west, and probably indicates an earlier stage in vegetation development, possibly because of less time for recovery after destruction by testing. Tests conducted just to the east of these islands as late as 1958 produced blast and thermal effects which removed most of the vegetation from these islands.

Samples collected on Ruchi Island were <u>Messerschmidia</u> and <u>Scaevola</u> and a 300-in.³ soil sample.

DAISY (Cochiti)

Vegetation of Cochiti Island is a scattered to open scrubby growth of <u>Messerschmidia argentea and Scaevola</u> <u>frutescens</u>. The density of vegetation is reduced on the northeastern tip of the

island and somewhat so along the entire lagoon side of the island. Coconut paims (Cocos nucifera) with fruit were found on the island. Open ground between the scattered clumps of Messerschmidia and Scaevola was covered with Fimbristylis atollensis, Triumfetta procumbens, and Ipomoea ssp. In addition to the Messerschmidia, Scaevola, and <u>Cocos</u>, a 250 to 300-in.³ soil sample was collected from the island. Messerschmidia and Scaevola was covered with Fimbristylis atollensis, Triumfetta procumbens, and Ipomoea ssp. In addition to the Messerschmidia, Scaevola, and Cocos, a 250 to 300-in. soil sample was collected from the island

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EDNA (Sanildefonso)

EDNA is hardly more than a sandbar occurring on the northern part of the reef. It lies just west of the MIKE Crater and may represent coral ejecta from that shot. The only vegetation on the island, except for algae in the surf, is the tree <u>Messerschmidia argentea</u> which, even with a low salt tolerance, is usually one of the initial invaders of a new land surface. Trees are present on the northern half of the island. A rather large population of hermit crabs is also present, apparently subsisting on the vegetal debris from these plants.

The only sample collected from this island was from Messerschmidia.

HELEN (Bogairikk)

HELEN is a small vegetated sandbar contiguous with IRENE (Bogon), extending from the northwest to the southeast, and connected to Bogon by a sandbar. It is covered with an open growth of ong the entire Coconut palma were found l between the rschmidia with riumfetta ssp. In addi-Scaevola. soil sample nd. la was cov- ' ensis, d Ipomoea serschmidia. to 300-in. om the island

n a sandbar art of the MIKE Crater cta from that the island, is the tree lich, even usually one w land surthe northern large popso present, vegetal

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ed sandbar n), extending theast, and par. It is pf Messerschmidia argentea and Scaevola frutescens. Some rank growth of the grass Lepturus repens has occurred in the open areas, encouraged by the manuring effects of the small bird rookery present on the island. A small plant of the tree, <u>Guettarda speciosa</u>, was seen on Bogairikk Island.

The grass, <u>Lepturus repens</u>, and a soil sample were collected on this island.

IRENE (Bogon)

The vegetation of IRENE is composed of scattered to open scrubby growth of Messerschmidia argentea and Scaevola trutescens. Other woody species are present on the island but contribute only in a small way to the vegetative biomass. Tree growth is slightly more dense around the eastern rim of SEMINOLE crater than in other areas. Open expanses of ground between tree clumps is covered with the usual ground cover species: Fimbristylis atollensis, Triumfetta procumbens, Ipomoea pescaprae, and related species. The parasitic Cassytha filiformis was particularly abundant in these areas. Other species observed were Guettarda speciosa, Suriana maritima, and a single group of coconut palms, Cocos nucifera. Collections were made of these species and of two kinds of animals present on the island; noddy terns and cggs were obtained, as well as hermit crabs from the central part of the island. Soil samples were obtained from the three corners of the island. A slightly more radioactive area was present on the northwest corner of the island, and this was sampled by both soil and plant collections.

JANET (Engebi)

Vegetation of Engebi is dense to open scrubby growth of Messerschmidia argentea and Scaevola frutescens, with a few other woody species assuming only local importance. Scaevola dominates the vegetation on much of the interior of the island but occurs with Messerschmidia in mixed stands on other parts of the island, such as along the north side of the airstrip. In old cleared areas, shrubs such as Pluchea odorata are abundant and form large clumps 10 to 30 ft in diameter. Fimbristylis atollensis (sedge) forms tussocks 4 to 6 in, in diameter in open areas between shrub and tree clumps, with the ground-cover species, Ipomoeae pes-caprae and Triumfetta procumbens. A small clump of coconut palms with young fruit was present to the east of the large concrete building in the center of the island. Other woody species observed were Morinda citrifolia and Sida fallax. Plant samples were collected along two transects of the island. One transect of the island was made along the axis of the lagoon side, and both Messerschmidia and Scaevola were sampled along this transect. Another transect was made from the northwestern tip parallel to the airstrip toward the northeastern corner of the island.

Rats were trapped in three areas on Engebi Island, the first near a slightly more radioactive area on the north side of the airstrip, the second near a bunker at the northwest tip of the island, and a third near the main building at the center of the island. Noddy tern eggs and birds were obtained on the north side of the airstrip.

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KATE (Muzinbaaikku)

Vegetation of KATE is composed of scattered to dense growth of Messerschmidia argentea and Scaevola frutescens. Stands of the tree Pisonia grandis occur on the southern and northeastern portions of the island, with an open Messerschmidia-Scaevola scrub occupying the central portion. This is the northernmost island on which Pisonia grandis trees occur, and it will very likely act as a dispersal center for this species in the northern half of the Atoll. The significance of Pisonia is that it is an indicator species of the mature climax vegetation of the Atoll. Higher organic matter content of the coral sand soil is observed in Pisonia stands, and the nesting of fairy and noddy terns in Pisonia trees results in higher levels of nutrients in the terrestrial ecosystem.

Other species encountered on Muzinbaaikku Island were <u>Morinda citri-</u> <u>folia</u> and the ubiquitous ground-cover species, <u>Fimbristylis atollensis</u>. <u>Ipomoea</u> <u>pes-caprae</u>, <u>Lepturus repens</u>, and <u>Triumfetta procumbens</u>.

The red-tailed tropicbirds (<u>Phaethon</u> <u>rubricauda</u>) were sampled, and a $12 \times 12 \times 1$ -in. deep soil sample was obtained on this island.

<u>LUCY (Kirinian)</u>

The vegetation of LUCY is composed of a dense <u>Messerschmidia argentea</u>-<u>Scaevola frutescens</u> growth which assumes an open, scattered aspect on the southern tip of the island. <u>Scaevola</u> typically occupies the island margins, apparently being more salt-tolerant, with <u>Messerschmidia</u> occurring inland and persisting in the vegetation type even when a <u>Pisonia</u> sta_{nd} develops. Salt damage can be seen in bou <u>Scaevola</u> and <u>Messerschmidia</u>.

Noddy terns, hermit crabs (<u>Coenobit</u> <u>perlatus</u>), and a soil sample (250 to 300 in were obtained on this land.

MARY (Bokonaarappu)

The vegetation of Bokonaarappu is an open <u>Messerschmidia argentea-Scaevola</u> <u>frutescens</u> scrub which is densest on the central and northern parts of the island. Several coconut palms (<u>Cocos nucifera</u>) are present and bearing fruit. Other wood species on the island were <u>Morinda citri-</u> <u>folia</u> and <u>Guettarda speciosa</u>. <u>Morinda</u> leaves and fruit were collected, as well as coconuts from six palm trees. A soil sample was collected from a 12 × 12 × 1-ia (depth) area. Noddy terns were also obtained.

NANCY (Yeiri)

This small island is covered with a dense growth of <u>Messerschmidia</u> <u>argentea</u> and <u>Scaevola frutescens</u> along the shorelines, with <u>Pisonia grandis</u> occupying the interior. The vegetation apparently has not been modified as much as some adjacent islands, and species indicative of a more advanced successional stage are present. <u>Pisonia grandis</u>, <u>Guettarda</u> <u>speciosa</u>, <u>Cordia subcordata</u>, and <u>Morinda</u> <u>grandis</u> occur on this island with the coconut palm, <u>Cocos nucifera</u>. It appears that the condition of islands in this part of the Atoll must be very similar to conditions prevailing before World War II.

All plant species listed above were sampled, and a soil sample was obtained. Two young coconut crabs (<u>Birgus latro</u>) approximately 6 in. long were found but were relea: they were t

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The vegscattered to <u>Messersch</u> frutescens, more open, and <u>Scaevo</u> lected on th and <u>Cordia</u> A soil s island, and the beaches

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The veg of scattere and <u>Scaevc</u> than on A north. Th physical ϵ vegetation succession <u>Messersc</u> <u>Morinda c</u> A 12 × 12 sample of <u>(Rattus es</u> the islanc

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OLIVE (Aitsu)

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The vegetation of OLIVE is composed of scattered to dense scrubby growth of <u>Messerschmidia argentea</u> and <u>Scaevola</u> tratescens. The south end of the island is more open. In addition to <u>Messerschmidia</u> and <u>Scaevola</u>, other species found and collected on the island were <u>Morinda citrifolia</u> and <u>Cordia subcordata</u>.

A soil sample was collected on the island, and noddy terms were obtained along the beaches.

PEARL (Rujoru)

The vegetation of PEARL is composed of scattered <u>Messerschmidia argentea</u> and <u>Scaevola frutescens</u> growth, less dense than on Aitsu or Yeiri Islands to the north. This island was subjected to physical effects from a test, and the vegetation is in a relatively immature successional stage. In addition to <u>Messerschmidia</u> and <u>Scaevola</u>, a sample of <u>Morinda citrifolia</u> was collected on PEARL. A $12 \times 12 \times 1$ -in. (deep) soil sample, a sample of noddy terns, and eight rats (<u>Rattus exulans</u>) were also collected on the island.

RUBY (Eberiru)

This small island is composed primarily of coral sand and coralline limestone. The only woody vegetation found on the island was <u>Messerschmidia argentea</u>, which is usually the primary invader species on bare sandbars. <u>Fimbristylis atollensis</u> sedge is present between the trees.

SALLY (Aomon)

SALLY has been modified by recent earthmoving activities connected with the PACE experiments. Between a third and a half of the island has been cleared of vegetation, and bare coral sand and limestone are exposed on most of its southern half.

Remnants of the pre-PACE Program vegetation appear to be the typical <u>Messerschmidia argentea-Scaevola</u> <u>frutescens</u> scrub growth. Scattered clumps or trees of these species occur on the northern half of the island. <u>Pandanus</u> sp. plants were found on SALLY but no fruits were present. Revegetation studies could be conducted on the cleared areas to obtain data on recovery rates of the atoll vegetation because the date of clearing is known.

Noddy and sooty terns and eggs were collected, and a soil sample was obtained from an undisturbed part of the island.

TILDA (Biijiri)

The vegetation of TILDA is composed of scattered to dense stands of <u>Messerschmidia</u> <u>argentea</u> and <u>Scaevola frutescens</u>, with vegetation in the center of the island more dense than that on the north side of the runway. Other species found on the island which make a significant contribution to the plant biomass are <u>Pisonia grandis</u>, <u>Guettarda</u> <u>speciosa</u>, <u>Morinda citrifolia</u> and <u>Pandanus</u> sp. <u>Pisonia</u> trees on the northeast corner of the island showed some damaged foliage, probably due to salt spray. A young coconut palm, <u>Cocos nucifera</u>, was found on the island, but only small, green, immature fruit was available.

A soil sample was collected.

<u>URSULA (Rojoa)</u>

The vegetation of URSULA is composed of scattered to dense growth of <u>Messer-</u> <u>schmidia argentea-Scaevola frutescens</u>. Vegetation on the north and western parts of the island was dense and essentially continuous, while trees on the southeast third of the island were scattered. <u>Guettarda speciosa</u> was the only other woody species observed on the island.

Rats (<u>Rattus exulans</u>) were abundant on on URSULA, and a large sample of animals was obtained in a daytime trapping trip. A soil sample was also obtained.

VERA (Aaraanbiru)

The vegetation of VERA is an example of mature Atoll vegetation, similar to that seen on islands in the southeastern sector of the Atoll. Along the shorelines, Scaevola frutescens and Messerschmidia argentea occur in dense, scrubby growth. The west central part of the island supports a stand of mature coconut palms, Cocos nucifera. In the central part of the island the vegetation is dominated by large trees of Pisonia grandis. Within the stands of Pisonia, old stems of Messerschmidia may persist but do not show much reproduction except by vegetative means such as stem shoots. Morinda citrifolia and Pandanus sp. were also present in the dense forest type on Aaraanbiru Island.

The soil on Aaraanbiru Island had a large amount of organic matter in it. Raw organic matter and organically stained coral sand extended as deep as 20 cm.

WILMA (Piiraai)

The vegetation of WILMA is scattered to dense growth of <u>Messerschmidia</u>

argentea and <u>Scaevola frutescens</u>. The southern half of the island is more open, which may be related to the test activity on the next island to the south, <u>YVONNE</u>. <u>Guettarda speciosa</u> was the only other woody plant observed in addition to those mentioned above. The usual ground-cou species, such as <u>Fimbristylis atollensis</u> <u>Triumfetta procumbens</u>, and <u>Ipomoea</u> <u>pes-caprae</u> were present in open or disturbed areas, such as near the helicopter pad and in the central portion of the island.

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YVONNE (Runit)

The vegetation of YVONNE is primarily scattered, scrubby growth of <u>Messerschmidia argentea</u> and <u>Scaevola</u> <u>frutescens</u>, although other woody plants, such as <u>Guettarda speciosa</u>, an early invader of disturbed sites, and the coconut palm, <u>Cocos nucifera</u>, were also found. Open spaces are generally vegetated by typical ground-cover species such as <u>Fimbristylis atollensis</u>, <u>Triumfet</u> <u>procumbens</u>, <u>Lepturus repens</u>, and <u>Ipomos</u> <u>pes-caprae</u>.

Several series of vegetation samples were collected on Runit Island. At the north end of the island, south of Cactus and Lacrosse craters, <u>Messerschmidia</u>, <u>Scaevola</u>, and <u>Guettarda</u> were collected. A soil sample was also collected here, and rats were trapped in this area of higher radioactivity. We have called this group of samples Series A.

Farther south, but still north of the metal tower, Series B samples were collected, including <u>Messerschmidia</u>, <u>Scaevola</u>, <u>Cocos</u>, a soil sample, and a r sample. Noddy terns and their eggs wer also obtained. Slightly south of the landing dock another series of samples, designated Series (I was obtained, including samples of <u>Messerschmidia</u>, <u>Scaevola</u>, <u>Cocos</u> (truits), and soil collected along the old airstrip runway. Noddy tern eggs and a series of rats were also obtained in the "C" area.

The "D" area of Runit was at the southern end in an area of old buildings at the end of a long sand spit. <u>Messerschmidia</u>, <u>Scaevola</u>, and <u>Cocos</u> (runts) were collected. In addition, noddy tern eggs were collected, rats were trapped, and two soil samples were obtained for Series "D".

A fourth area, designated the "E" area, was also sampled. This area was located mid-island, but on the seaward side. <u>Messerschmidia</u>, <u>Scaevola</u>, and a soil sample were obtained.

Small Islands Between YVONNE (Runit) and ALVIN (Chinieero)

Four small islands, hardly more than sand spits, occur on the reef between YVONNE (Runit) and ALVIN (Chinieero). These islands apparently had no geographic or native names; perhaps they have formed in recent years. Vegetation of these small islands represents initial stages of plant succession.

<u>SAM</u>

This small sandbar or spit is located just south of YVONNE (Runit) and has several small clumps of <u>Messerschmidia</u> <u>argentea</u> and small patches of grasses between them. No samples were collected on SAM.

TOM

This is a small triangular island on the reef south of YVONNE with sandbars extending from the north and south ends of the island. Two species of woody plants occur on TOM -- <u>Messerschmidia argentea</u> and <u>Scaevola frutescens</u>. These two plants occurred in separated clumps on the island with little ground vegetation in between, and samples of each were collected.

URIAH

This long, narrow island is covered with scattered to dense growth of <u>Messerschmidia</u> <u>argentea</u> and <u>Scaevola frutescens</u>. Groundcover species are present between the tree clumps in the more open areas, and the south end of the island. <u>Messerschmidia</u> and <u>Scaevola were collected</u>.

VAN

VAN is a small, densely vegetated island just north of ALVIN (Chinieero). Sandbars are present at the northern and southern ends of the island, and coral limestone occurs at the water's edge along the lagoon. <u>Messerschmidia</u> <u>argentea</u> and <u>Scaevola frutescens</u> dominate the vegetation, which also includes <u>Pisonia</u> <u>grandis</u>, the large, soft-wooded tree found on islands with mature, undisturbed vegetation. The sea side of the island at the southern end has vegetation which is more scattered than on the northern and lagoon sides. Noddy terns and eggs were collected from the small rookery of birds.

ALVIN (Chinieero)

ALVIN is a small island in the center of an elongate sandbar located on the lagoon edge of the reef. Broad sand beaches are present on the lagoon side The vegetation of Chinieero Island is composed mainly of <u>Messerschmidia</u> <u>argentea</u> with a few clumps of <u>Scaevola</u> <u>frutescens</u>.

BRUCE (Aniyaanii)

The main portion of BRUCE is covered with an intermediate-age <u>Pisonia grandis</u> forest. There does not appear to have been large-scale destruction of habitat on this island, although test-period activity is apparent on the north end.

Scattered coconut palms are present in the central and eastern part of the island. The island edges, and old cleared areas support clumps of <u>Messerschmidia</u> <u>argentea</u> and <u>Scaevola frutescens</u>, and a thicket of <u>Cordia subcordata</u> is present along the lagoon beach. <u>Ipomoea</u> ssp. and <u>Triumfetta procumbens</u> vines and clumps of <u>Lepturus repens</u> and <u>Fimbristylis</u> <u>atollensis</u> occur in the limited number of open meadow-like areas.

Coconut crabs, <u>Birgus latro</u>, and the roof rat, <u>Rattus rattus</u>, were seen, and coconut crabs were collected for analysis. All the plant species listed above except <u>Ipomoea</u>, <u>Triumfetta</u>, <u>Lepturus</u>, <u>Fimbristylis</u>, and <u>Cordia</u> were sampled.

CLYDE (Chinimi)

CLYDE is a small, rectangular islet with large lagoon beaches and a broad coral reef exposed on the sea side, scarcely more than a spit. A large population of sooty terns was nesting there in January.

The vegetation of CLYDE is scattered to open scrub of <u>Messerschmidia</u> argentea

and <u>Scaevola frutescens</u> with grasses, mainly <u>Lepturus repens</u>, occurring in the areas not occupied by shrubs. Several basin-like depressions, possibly solution pits, occur on the island, which received large amounts of bird guano during the course of one or more nesting periods.

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Birds (sooty terns) and eggs, and <u>Messerschmidia</u> and <u>Scaevola</u> were collected.

DAVID (Japtan)

DAVID is one of the largest islands on the Atoll, lying just north of the deep passage on the southeastern portion of the reef. On the western half of the island, a coconut palm plantation is present, but much of the area has been recolonized by the two ubiquitous shrub species, <u>Messerschmidia</u> and <u>Scaevola</u>. Vines, grasses, and sedges which typically invad bare ground, were found throughout the island.

Small clumps of arrowroot, <u>Tacca</u> <u>leontopetaloides</u>, were found in openings and among the palms on the western half of the island.

The eastern half of DAVID is covered with a dense growth of <u>Pisonia grandis</u>, <u>Ochrosia oppositifolia</u>, <u>Messerschmidia</u> <u>argentea</u>, and <u>Scaevola frutescens</u>. Occasionally <u>Guettarda speciosa</u> and <u>Morinda citrifolia</u> are found at the edges of this forest. A single large specimen of <u>Pandanus</u> sp. was found in the central part of the island at the eastern edge of the coconut grove.

There is a large number of weedy plan species on DAVID. This island was at least partially covered in the pre-World War II period of colonization by imported soil.

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The island supports a modest population g root rats. The monitor lizard is common. palms, <u>Cocos nucifera</u>, are present hary terns nest in the mature Pisonia prests, and the reef heron was seen along the southern beach.

Samples taken on DAVID included Messerschmidia, Scaevola, Pisonia, Gattarda, Morinda, Tacca, Pandanus, Coenobita, Rattus exulans, Demigretta, Erolia, and Sterna.

REN

This small, arcuate island and spit lies in the deep passage at the southeast end of the lagoon. A large sand beach is present at its northwest end, while the eastern and southern shores have narrow beaches and broad exposed reefs.

REX is covered with heavy growth of Messerschmidia argentea and Scaevola frutescens, with some large specimens of Pisonia grandis. The west end of the Island has several large open areas which support scattered clumps of grasses and sedges. A few birds were nesting on this part of the island (sooty terns), and birds and eggs were collected.

ELMER (Parry)

Parry Island was the scene of intense test-period activity at the Atoll and is still covered with metal and wooden buildings, concrete pads, and miscellaneous structures. A small airstrip, partially overgrown with Ipomoea and Triumfetta vines, is located on the southern half of the island.

Scattered Messerschmidia argentea and <u>Scaevola frutescens</u> shrubs occur between the buildings, especially on the eastern or

seaward side of the island. Young coconut around some buildings. Ipomoea and Triumfetta vines and the parasitic Cassytha filiformis are invading most of the bare sand and gravel areas between buildings.

The roof rat, Rattus rattus, occurs on Parry Island, where it must subsist mainly on the few coconuts produced there and the seeds of flowering plants.

FRED (Enewetak)

FRED is an elongated island at the southeast end of the Atoll, separated from the islands in the southwestern guadrant of the Atoll by the wide passage through the reef. Most of the recent activity (1960-1973) at Enewetak Atoll has been on this island, which has a long airstrip at its southern end. Bombardment and ground fighting on Enewetak Island during World War II destroyed most of the original vegetation and natural features. Subsequent support and construction activities during the nuclear test period further modified the island with building complexes, concrete pads, and roads.

The present vegetation of FRED consists of the widely distributed species of the Atoll — some of which were replanted by man - and weedy species introduced from North America. The coconut palm has apparently been replanted by man on Enewetak Island during the nuclear test period and thereafter. Other species include the Pandanus and various horticultural, agricultural, and weedy species.

Messerschmidia argentea and Scaevola frutescens are the most common woody plants on Enewetak Island. Large Messerschmidia trees are estimated to be 10-20 yr old, but only a few specimens of this age are present.

Ground cover includes species of <u>Ipomoea, Triumfetta procumbens,</u> <u>Lepturus repens, Fimbristylis atollensis,</u> and the parasitic <u>Cassytha filiformis</u>. None of the commoner woody species found on islands to the north or west, such as <u>Guettarda speciosa</u> and <u>Morinda citrifolia</u> was seen on FRED.

Mammals were represented on the island by the house mouse, <u>Mus musculus</u>, which was trapped in small numbers around buildings being used for habitation. Several cats and dogs were present on the island, and it is possible that their predation upon the larger roof and Polynesian rats kept their numbers low.

GLENN (Igurin), HENRY (Mui), IRWIN (Pokon), JAMES (Ribaion), and KEITH (Giriinian)

These five islands in the southwest quadrant of the Atoll can be considered as a group with a similar ecological setting, history, and biota. The description to follow therefore applies to all of the islands, with few minor differences. Except for two nuclear tests conducted in the adjacent lagoon or in the sea just south of the Atoll, these islands have not been disturbed, as have the islands on the northern part of the Atoll. Only a few test-related structures are present on these islands, and these are almost obscured by the heavy growth of vines, shrubs, and trees.

Vegetation of these islands is primarily the <u>Pisonia grandis</u> forest, with such subdominant species as <u>Ochrosia oppositifolia</u>, <u>Morinda citrifolia</u>, and <u>Guettarda speciosa</u>. <u>Suriana maritima</u> and <u>Pemphis acidula</u> are found occasionally at the edges of the beach. <u>Messerschmidia argentea</u> and <u>Scaevola frutescens</u> are typically found at the edges of the <u>Pisonia</u> forest stands with old stems of <u>Messerschmidia</u> occasionally persisting under the compl canopy of the <u>Pisonia</u> forest. <u>Tacca</u> <u>leontopetaloides</u>, the arrowroot, was found on several of the islands in small patches. A few small <u>Pandanus</u> trees we seen. On some islands, such as GLENN and KEITH, large coconut palms are present among the <u>Pisonia</u> trees, while on smaller islands younger palms are found, mainly on the lagoon sides of the islands.

The terrestrial biota of this series of islands is the most interesting of those found on the Atoll. Coconut crabs, <u>Birru</u> <u>latro</u>, are usually found wherever producing coconut palms are present. On Iguria and Giriinian Islands coconut crabs are quite abundant, together with the land for of the hermit crab, <u>Coenobita brevimanu</u> and the related C. perlatus.

In the <u>Pisonia forest</u>, the fairy tern and the common noddy are found nesting with out any serious predation. A considerable amount of bird guano is deposited in these forest stands, and the coral substratum has become darkly stained through the action of organic matter accumulation.

The Polynesian rat, <u>Rattus exulans</u>, was found on GLENN, where it is apparently able to subsist on coconuts and other plant and animal materials. O HENRY, a narrow, spit-like extension of the island (east end) has a small rookery of sooty terns nesting in the grassy ridge just above the beach.

It is quite possible that the vegetation of this series of southwestern islands is affected by storm waves and spray. Stor waves cant ar Numer spray (tagoon

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aves from the lagoon can deposit signifient amounts of salt spray on the islands. Numerous plants with symptoms of salt spray damage were observed along the lagoon side.

LEROY (Rigili)

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LEROY is a small, rectangular land mass located on the southwestern part of the Atoll, separated from ALICE to the north by 21 km, and from KEITH to the cast by 12 km of open water and coral reefs. The approach to LEROY from the lagoon is complicated by extensive reefs and tidal flats.

LEROY can be considered unique among islands on the southern half of the Atoll from a radioecological standpoint for two reasons, the second of which is probably more important: (1) Two nuclear tests were conducted relatively close to the island, one in the lagoon and one in the sea to the south; and (2) the island received close-in fallout from tests conducted in the northeast quadrant of the Atoll because fallout clouds frequently left the Atoll in a southwesterly direction.

LEROY has a well-developed sand beach on the lagoon, or northeast, side of the island. A narrow beach with exposed coral limestone occurs on the other three sides of the island. The island is densely vegetated, except for a few openings on the northeast side of the island. Large specimens of <u>Pisonia grandis</u> and coconut palm, <u>Cocos nucifera</u>, form the dense forest which extends almost to the beaches on all sides. The usual transition zone composed of <u>Messerschmidia argentea</u> and <u>Scaevola frutescens</u> occurs at the edges of the forest, with a few mature trunks of <u>Messerschmidia</u> located in the outer edges of the <u>Pisonia</u> forest.

On the southwest side of the island dense <u>Cordia subcordata</u> thickets occurred at the outer edge of the <u>Pisonia</u> forest. <u>Pemphis acidula</u>, a tall shrub, was seen among the <u>Scaevola</u> and <u>Messerschmidia</u> just above the storm line on the lagoon beach. A large specimen of <u>Pandanus</u> sp. was found on the southeast beach among the <u>Scaevola</u> and <u>Messerschmidia</u>. No fruit was present but foliage samples were collected. Mature coconut-producing palms were scattered through the island in the <u>Pisonia</u> forest.

Fairy terns and the common brown noddy were nesting in the <u>Pisonia</u> trees at the time of sampling in January. Coconut crabs (<u>Birgus latro</u>) were abundant on the island, and several large specimens were obtained for radionuclide analysis. Except for migratory birds and the hermit crab, <u>Coenobita perlatus</u> and <u>C. brevimanus</u>, no other animals were seen on the island.

Sampling and Sample Preparation

The collection of terrestrial biota on Enewetak Atoll was based on three main criteria: (1) plant or animal species comprising the anticipated diet, (2) plant or animal species not usually considered as food, but included in the Marshallese pharmacopoeia or used as famine food, whose distribution over most of the Atoll permits comparison on an inter-island basis, and (3) plant or animal species not forming part of the Marshallese diet, but considered as "indicator" organisms bearing some relationship to species that might be introduced later. Examples of the first category include Pandanus tectoris, coconuts (Cocos nucifera),

arrowroot (<u>Tacca leontopetaloides</u>), and coconut crabs (<u>Birgus latro</u>). Examples of the second category include <u>Morinda</u> <u>citrifolia</u>, <u>Messerschmidia argentea</u>, and <u>Scaevola frutescens</u>. An example of the third category is the rat, the only mammal inhabiting the islands at present.

Representatives of less widely disseminated plant species were collected wherever adequate samples were available. For example, only two stands of tacca were observed, one on DAVID and the other on LEROY; the first was mature and had numerous tubers, but the second was immature and had inadequate tubers for sampling. Specimens of pandanus leaves were collected on 10 of the islands, but only two of the plants were bearing fruit.

Terrestrial animals on the Atoll were limited to large hermit crabs (Coenobita perlatus), coconut crabs (B. latro), rats (Rattus rattus and R. exulans), and monitor lizards introduced by the Japanese on Japtan (DAVID). The lizards are not eaten by the natives; they are a protected species and were not collected. Rats are not eaten by the natives but are useful as indicator organisms since they are the only mammals on the Atoll. The coconut crab, a terrestrially adapted species, is considered a delicacy. These animals in turn derive their nutrients primarily from land vegetation. The supply of coconut crabs is severely limited.

Birds and their eggs constitute important food items for the natives; both are plentiful and were collected on many of the islands. These birds are primarily ocean or reef feeders (small fish, squid, shrimp, etc.) and are far-ranging in their feeding habits.

Collection and Preparation for Analysia

Plant Samples — Immediately after collection plant samples were placed in forced-air drying ovens at 125 to 150°C for approximately 24 hr or until dry. Coconuts were drained of milk, and the meats dried. All samples were packaged in plastic bags for shipping. At LLL they were ground in a Wiley mill, redried. packed in aluminum tuna cans with a hydraulic press, and sealed for counting. The cans were submitted for gamma counting with lithium-drifted germanium Ge(Li) detectors and wet chemistry. Most of the samples were larger than required for canning; the excess provided a duplicate sample to keep in reserve for other procedures as required.

A number of green drinking coconuts were collected in July 1973 from selected islands for analysis of the milk. The milk was drained from the nuts and freeze-dried. This was packed in small plastic jars for gamma counting and subsequent radiochemical analyses. The meats from these nuts were dried as above and also submitted for analyses.

<u>Mammals</u> — Rats were collected with snap traps. Our own collections on some islands were supplemented from the EMBL^{*}-Bowling Green collection of rats in return for data on the reproductive organs of the rats collected by our group. Two species were obtained: <u>Rattus</u> <u>exulans</u> (Polynesian rat) and <u>Rattus rattus</u> (roof rat). On all the islands except DAVID, the rat population appeared to be

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Enewetak Marine Biological Laboratory.

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coconuts n selected . The milk reeze-dried, ic jars for t radiofrom these iso sub-

ected with is on some in the on of rats uctive our group. <u>ttus</u> <u>ttus</u> rattus xcept ared to be

aboratory.

exclusively either one species or the other. Rats were frozen in deep-freeze chests on Enewetak, returned to LLL packed in dry ice, and stored frozen until dissection and analysis. Thawed specimens were dissected for organ samples (skin, liver, kidney, lung, viscera, and carcass), which were then freeze-dried. Bone and muscle were separated. Bone was ashed at 150°C. All samples were canned for analysis. Species identification of <u>Rattus</u> rattus and <u>Rattus exulans</u> was confirmed by Dr. Jackson at Bowling Green University.

Birds - Birds were shot with a shotgun or captured by hand. The principal species collected were the common noddy (Anous stolidus), the white-capped noddy (Anous tenuirostris), and the sooty tern (Sterna fuscata). A few specimens of the red-tailed tropic bird (Phaeton rubricauda). reef herons, and curlews were taken, but some of these provided inadequate sample sizes for analysis. The birds were frozen with dry ice for shipment. At LLL they were thawed, skinned, and dissected into samples of carcass, liver, and viscera. Individual organ samples were pooled by species and freeze-dried. Muscle and bone were separated; the bone was ashed in muffle furnaces at 150°C, washed with distilled water to remove muscle residue. and redried. Liver, muscle, bone, and viscera were canned or packed in smaller plastic containers and submitted for analysis.

Eggs were collected from nests on the ground, where large numbers were available. They were frozen for shipment. For analysis, the shells were separated, washed, and dried. The edible contents were freeze-dried and canned. Identification of the birds collected on the islands was confirmed by George Watson at the Smithsonian Institute.

Terrestrial Crustaceans — Coconut crabs (Birgus latro) were freeze-dried whole with the exoskeleton cracked to facilitate drying. At LLL they were dissected into samples of exoskeleton. muscle, tail (hepatopancreas and reproductive organs), and a miscellaneous fraction containing other viscera. These were then canned for analysis. Coenobita perlatus (hermit crabs) were frozen at Enewetak and partially defrosted at LLL so that they could be removed from their shells. They were separated into tails (hepatopancreas) and anterior portions and freeze-dried. Anterior portions were crushed, and muscle and exoskeleton were separated. The fractions were canned for counting.

<u>Soil Samples</u> — Intensive soil-profile sampling of the Atoll was in progress concurrently, but we collected additional samples near areas of intensive sampling of vegetation, in order to determine the soil-plant transfer ratios for specific isotopes. They consisted of $12 \times 12 \times 2$ in. samples, which were dried, homogenized, and canned in aluminum tuna cans for counting. They were processed along with the samples from the soil-profile studies.

Radionuclide Concentration Levels in Terrestrial Biota Samples.

A total of 1103 specimens were collected in the field as part of the terrestrial biota
survey, distributed as follows:

Soils	42
Plants	208
Birds	116
Eggs	217
Rats	249
Crabs	271
Total	1103

Because many of the individual samples of birds, eggs, rats, and crabs were too small to yield statistically meaningful analytical results, specimens of the same species from a single area were pooled, resulting in the analysis of a total of 273 samples in these four categories.

Radiochemical analytical data for the terrestrial biota samples are shown in Table 59, listed by island, starting with ALICE. Results for all radionuclides whose analytical errors are less than 30%are tabulated. Nuclides with errors greater than 30% are present at close to the analytical sensitivity limit and are therefore considered to have negligible value for dose-assessment purposes. Those who wish to use data for these nuclides, plus upper limit estimates for each sample where a specific nuclide was not observed, are referred to the microfiche tables in Appendix II.

These basic survey data have been arrayed in two additional ways to facilitate their interpretation and use. In Tables 60 to 75 the survey data are ordered on the species of organism. In Tables 76 to 103 the basic survey data are arranged by island and include the soil, plant, and animal data obtained from the site. Table 59. Terrestrial biota samples collected at Enewetak Atoll, Oct. 1972 - Jan. 1973.Radionuclide concentration levels, pCi/g ovendry wt (error, %)

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negligible

Sample No.	Туре	40 _K	⁵⁵ Fe	⁶⁰ Co	90 _{Sr}	¹³⁷ Cs	239,240 _{Pu}	Other
ALICE								
10188501	Messerschmidia argentea	13.38 ± 6.4			138.3±1.0	222.8±0.3	0.025±8.0	
1018910 1	<u>Guettarda</u> speciosa	11.03 ± 4.3				7.41±1.1		
10188601	<u>Scaevola frutescens</u>	12.82±5.5			32.7 ± 2.1	66.53±0.5		
1191900 1	Anous stolidus liver	10.20±18.8	127.0±2.0				0.062±13.0	
11921201	Anous stolidus viscera		47.30±4.6					
11922801	Anous stolidus muscle	9.66±8.3	49.55±2.0	0.321±21.7	0 .0099±25.	0		
11926001	Anous stolidus bone	5.302±12.1	25.68±7.6		20 .59±9.9	1.16±4.3		
BELLE								
10226602	Guettarda speciosa Ieaves	12.48±5.8			152.7±1.0	109.1±0.4		
10226402	Messerschmidia argentea Ieaves	15.86±5.8			25.2±1.1	5.83±2.1	0.036±9.7	
10226502	Scaevola frutescens Ieaves	12.45±5.8			2.27±3.6	1.42±4.1	0,072±6.3	²³⁸ Pu (0.013±12.0)
10226702	Pandanus tectorius Ieaves	6.70±15.4	0.438±5.0		391.0±1.0	679.30±0.3		
10226802	Pandanus tectorius fruit	14.38±5.8			206.30±1.0	923.0±0.1		³ H (0.86±5.2)

Radionuclide concentration levels, pCi/g ovendry wt (error, %)

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Sample No.	Туре	40 _K	⁵⁵ Fe	⁶⁰ Co	90 _{Sr}	¹³⁷ Cs	239,240 _{Pu}	Other
CLARA								
10225503	<u>Messerschmidia</u> argentea leaves	13.33±5.0			127.5±1.0	149.10±0.3		
10225603	Scaevola frutescens leaves	12.37±5.5	3.37±8.6		51.8±1.0	15.04±0.6	0.048±13.0	
DAISY								
10245504	<u>Cocos nucifera</u> fruit	6.65±10.6			0.20±2.0	7.17±1.4		³ H (0.41±10.6)
10224304	Messerschmidia argentea Ieaves	11.10±4.9		1.45±5.1	12.21±1.0	5.90±1.4	0.055±9.8	102m _{Rh} (0.313±27.2)
10224404	Scaevola frutescens Ieaves	20.26±4.4		0.484±3.8	50.90±1.0	38.80±0.7	0.046±8.6	²³⁸ Pu (0.0085±16.0)
10930104	Cocos nucifera milk	45.50±24.7			1.40±12.0	1.75±47.0		
EDNA								
10720405	Messerschmidia argentea	11.1±5.3		0. 24±22 .8		6.73±1.4		
HELEN								
10411308	<u>Lepturus</u> repens grass	4.901±12.0		0.936±5.4	1.44±3.1	2.51±3.0	0.0435±21.0	0
IRENE								
10930309	Cocos nucifera							
10930409	Cocos nucifera	99.9±14.8	86,49±6.8		1.608±19.0	5.11±29.1		
10370909	Cocos nucifera	7.05±7.2			0.0667±8.0	1,769±3.2 (D,0362±8.0	

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10930409	Cocos nucifera
10370909	Cocos nucifera

99.9±14.8 86.49±6.8 7.05±7.2

1.608±19.0 5.11±29.1 0.0667±8.0 1.769±3.2 0.0362±8.0

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	Table 59 (continued).	Radionuclic	de concentra	tion levels,	pCi/g ovenc	ry wt (error	-, ‴ <u>o)</u>		
Sample No.	Туре	⁴⁰ K	⁵⁵ Fe	⁶⁰ Co	⁹⁰ Sr	137 Cs	239,240 _{Pu}	Other	
IRENE 10411709 (E-18)	<u>Guettarda</u> speciosa	8.14±6.9		9,18±5,0	53.60±1.0	27.33±1.9			
10411909 (C-16)	Lepturus repens	1,95±25.3		0.258±12.6	1.15±3.4	2 .57±3.3	0.0112±20.	0	
10329209 (B-5)	Messerschmidia argentea	13.04±4.6		23.86±1.1	536.0±1.0	62.6 ± 0.4			
10329509 (C-7)	Messerschmidia argentea	18.16±4.7		0.138±38.8		2. 1 97±3.1	0.0045±12.	0	
10329609 (A-1)	Messerschmidia argentea	14.6±5.1		2.77±4.1	21.76±1.0	4.10±2.3	0.0157±2.3		
10411609 (E-15)	Messerschmidia argentea	12.74±4.5		3.39±3.9	159.0±1.0	407.3±1.8	0.00192±8.	0	
10466309 (A-20)	Messerschmidia argentea wood	1.94 ± 16.1		1.59±3.2	1 6.98±1.1	13.02±2.2	0.00617±18	3.0	
10329309 (B-6)	Scaevola frutescens	17.09±4.7	$33.7{\pm}2.2$	47.4±0 .9	110.4 ± 1.0	43.14±0.6	0.0044±19.	$\frac{0}{(0.0044\pm19.0)} = \frac{241}{\text{Am}}$	ι.
10329409 (C-8)	Scaevola frutescens	14.08±5.2			1.14±5.5	1.67 ± 3.6	0.0031±1.0)	
10329709 (A-2)	Scaevola frutescens	12.68±5.9	26.4±2.8	17.07±1.6	8.56±1.0	4.28±2.8	0.0277±7.3	241_{Am}	
10411809 (E-14)	Scaevola frutescens	10.41±6.7		21.14±1.2	57.21±1.0	205.2±0.8	0.00296±29	.0	
10466409 (A-21)	Scaevola frutescens wood	1.817±15.6		0.912±3.5	4.60±2.4	2.219 ± 2.8	0.00295±22.	0	
10411409 (A-17)	Fimbristylis atollensis sedge	4.87±11.3		14.7±1.2	4.42±1.7	55.0±1.6	0.878±5.2	$\frac{238}{Pu}$ (0, 280±6 0)	
10411509 (A-19)	Suriana maritima	5.586±10.7		121.3±0.7	8.514±2.8	26.34±1.5	0.02865±16.	238_{Pu} (0,00905±29.)	

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Radionuclide concentration levels, pCi/g ovendry wt (error, %)

	Sample No.	Туре	40 _K	⁵⁵ Fe	⁶⁰ Co	⁹⁰ Sr	¹³⁷ Cs	239,240 Pu Other
	IRENE							
	11900709	Anous stolidus egg shell		1.18±22.0		7.34±1.6		0.0081±14.0
	11901409	Anous stolidus egg	6.374±7.5	23.0±2.0		0.095±5.0		0.0015±19.0
	11902509	Hermit crab hepatopancreas and gonad	7.045±10.3	12.8±3.0	82.8±0.8	29.7±2.0	124.3±0.5	$\begin{array}{c} 0.196\pm3.0 & {}^{3}\mathrm{II} \\ & (0.58\pm5.1) \end{array}$
	11902707	Hermit crab muscle	7.365±8.8	3.32±5.0	62.43±0.9	22.6±1.0	130.7±0.4	$\begin{array}{c} 0.\ 0694 \pm 4.\ 0 & {}^{3}\mathrm{H} \\ (0.\ 89 \pm 3.\ 6) \end{array}$
	11902809	Hermit crab exoskeleton	1 , 94±15. 2	0.321±5.0	1.66±5.0	491.0±1.0	27.2±0.7	0.0172±11.0
-242-	11917709	Anous stolidus muscle	9.419±9.9		0.25±39.3			
•	11919109	Anous stolidus liver	7,883±15,4	49.6±3.0	0.324±21 .9	0.509±3.0		0.0091±24.0
	11927409	Anous stolidus bone		57.66±3.0			0.171±40.2	
	11921309	Anous stolidus viscera		57.7±3.6				
	JANET							
	10368310	<u>Scaevola frutescens</u> I-18	17.44±4.8			12.16±1.0	30.50±0.8	0.01635±20.0
	10368410	<u>Scaevola</u> frutescens	18.12±3.9			37.25±1.0	258.60±0.2	
	10368510	Scaevola frutescens	14.31±5.0			17.34±1.0	63.29±0.5	
	10368610	Scaevola frutescens	13.65±5.1		0.446 ± 13.3	35.72±1.0	223,4±0,3	0.00267±28.0
	10368710	<u>Scaevola frutescens</u>	16.73 ±4. 8			31.53±1 .0	294.60±0.2	0.01036±13.0
		Table 50 (continued)						
		Table 56 (Continued).	Radionuclic	le concentra	tion levels,	pCi/g ovend	ry wt (error	<i>, "</i> / ₀)
		Turne	40 _K	55 _{Fe}	⁶⁰ Co	90 _{Sr}	¹³⁷ Cs	^{239,240} Pu Other
	Sample No.	The	11					

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Table 59 (continued).

Radionuclide concentration levels, pCi/g ovendry wt (error, γ_0)

Sample No.	Туре	⁴⁰ K	⁵⁵ Fe	⁶⁰ Co	⁹⁰ Sr	137Cs	239,240 _{Pu}	Other
JANET								
10368810	<u>Scaevola</u> frutescens	12.96±5.4		0 .2139±24.0	32.66±1.0	54.95±0.6	0.0067±5.8	238 _{Pu} (0.00676±8.7)
10368910	Scaevola frutescens	20,57±4,1		0.236±23.8	83.33±1.0	405.90±1.0	0.00432±17.0)
10369010	Scaevola frutescens	18.28±4.5			16.71±1.0	134. 1 0±0.4	0.00496±28.0)
10369110	Messerschmidia argentea	12.72±5.8			18.38±1.0	36.42±0.7	0.0152 ± 6.0	
10369210	Messerschmidia argentea	10.50±6.5			46.40±2.0	385.80±0.2	0.00345±21.0)
10369310	Messerschmidia argentea	9.95±7.2			43.51±1.0	124.80±0.4	0.00554±1.9	152 _{Eu} (0.204±33.3)
10369410	Messerschmidia argentea	142.5±5.1			48.20±2.0	299.40±0.2	0.0042±80.0	
10369510	Messerschmidia argentea	12.17±5.4			83.78±1.0	298.70±0.2	0.005±30.0	
10369610	Messerschmidia argentea	15.30±4.4			121.20±1.0	158.30±0.3	0.0029±26.0	
10369710	Messerschmidia argentea	10 .43±6.5		0.221±25.2	2 100.9±1.0	526.1±0.2		
10369810	Messerschmidia argentea	18.32±4.5		0.246±24.1	40.36±1.0	545.9±0.2	0.0103±24.0	
10369910	Messerschmidia argentea	13.29±5.8			45.95±2.0	322.7±0.2		
10370010	Pandanus tectorius Ieaves	8.12±9.10			4.41±2.0	0.62±8.5		²⁰⁷ Bi (0.11±29.0)
10370110	Pluchea odorata	10.80±6. 9		1.25±9.2	46.85 ±1 .0	1553.00±0.1		
10370210	Cocos nucifera	8.04±6.4			0.21±5.0	84.68±0.4		³ H(0.34±8.3)
11901010	Anous stolidus egg shell		1.28±20.0		16.04±1.4			
11901510	Anous stolidus egg	6.21±9.4	57.21±2.0		0.203±3.0		0, 0 14 8 ±5, 0	
11906610	Rattus rattus viscera	12.63±8.0		2.35±6.5	14.14±2.0	880.60±0.2	0.46±6.0	
11906810	<u>Rattus</u> viscera	11.38±16.8		1.97±13.4	6.85±2.0	768.00±0.3	0.36 ± 3.0	

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		Radionuclio	le concentra	tion levels,	pCi/g ovendry wt (error, %)			
Sample No.	Туре	40 _K	⁵⁵ Fe	⁶⁰ Co	⁹⁰ Sr	¹³⁷ Cs	239,240 _{Pu}	Other
JANET								
11907310	<u>Rattus rattus</u> muscle	8.74±8.4	30 .9±2.0	0.29±24. 5	1.28±4.0	764.00±0.2		³ H(6.7±1.1)
11909410	Rattus rattus liver	13.42±9.4	77.9±3.0	3.23±4.6	0.004± 9.0	632.9±0.8		
11910810	<u>Rattus rattus</u> viscera	16.23±9.9	24.3±5.5	4.95±3. 9	55.86±1.1	954.50±0.7	0.729±6.1	
11910910	Rattus rattus muscle		8.69±5.0	0.41±12.3	3.44±3.0	696.80±1.0	0.0076±13.	0
11911010	Rattus rattus muscle		10 .5±5.0	0.23±24.3	2.29±2.0	286.5±1.0	0.0097±10.	0
11911110	Rattus rattus viscera			1.72±6.2	17.0±1.0	273.2±1.1	1.40±2.0	
11911210	Rattus rattus muscle	13,87±10.4	16.3±6.0	0.638±15.9	3.14±4.0	765.8±0.8	0.0023±18.	0
11911310	Rattus rattus viscera	18.54±8.7		2.93±5.3	8.74±5.0	999.5±0.7	0.4 1±3. 0	
11912610	<u>Rattus</u> <u>rattus</u> liver	33.00±18.3	105.4±4. 0	2.56±14.7	0.015±8.0	741.9±1.0		
11912710	Rattus rattus liver	18.17±11.0	30.9±6.0	3.97±5.9		604.1±0.8		
11912910	<u>Rattus</u> Iiver		24.4±1.0	2.21±10.8	0.0073±8.0	211.5±1.2		
11913010	Rattus rattus liver		86,9±4,0	6.31±9.4	0.0072±18.0	897.7±0.9	0.018±21.0	¹⁵¹ Sm (34.3±3.0)
11916410	Rattus rattus bone	8.69±7.6		0.304±13.0	115.8±1. 0	661.2±1.6	0.26±4.0	
11916510	Rattus rattus bone	5.97 ±29 .5			133.8±1.0	357, 9+1, 9	0.17±9.0	

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Radionuclide concentration levels, pCi/g evendry wt (error, ".)

Sample No.	Туре	⁴⁰ K	⁵⁵ Fe	⁶⁰ Co	⁹⁰ Sr	¹³⁷ Cs	239,240 Pu Other
JANET					·····		
11917310	Anous stolidus muscle	9.19±8.1	104.5±2.0	0.51±15.1	0.008±24.0		0.002126.0
11917410	<u>Anous stolidus</u> viscera	10.68±19.3	63.96±4.0				
11917510	Terns: common noddy - W.C., S.T. pooled muscle	8.77±6.0	59.5±2.0	0.159±30.6	0.005±21.0)	0.005±9.0
11917610	Terns: pooled - CN, W.C., S.T. viscera	9.62±12.1	52.2±3.3			0.18±9.9	
11918110	Rattus rattus bone	9.06±11.3		0.218±27.9	68.9±2.0	129.2 ±1 .6	0.030±23.0
11918210	Rattus rattus bone			0.51±15.2	121.2±3.0	627.5±0.7	3.25±3.0
11919210	Anous stolidus liver	7.83±22.3	258.1±2.0		0.066±12.0	1	
11921410	Terns: pooled C.N, W.C., S.T., liver		171.6±2.0				0.0015±23.0
11924810	Rattus rattus bone	10.32±15.5		0.45±21.2	324.3±1.0	545.5±1.6	0.168±16.0
11926110	Anous stolidus bone	3.04±39.2	50.0±4.8		0.39±17.0	0.733±13.8	
11926210	Terns: pooled C.N, W.C., S.T., bone	3.32±23 .9	39.95±7.5				
10930510	<u>Cocos</u> nucifera fruit	60.05±10.0			1.57±6.0	210.7±1.8	
11907810	Rattus rattus skin					352.9±0.5	
11907910	Rattus rattus skin	6.05±19.6				389.8±0.4	
11908010	Rattus rattus	7.8±20.7				180.8±0.6	

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Sample No.	Туре	⁴⁰ K	⁵⁵ Fe	⁶⁰ Co	90 _{Sr}	137 Cs	^{239, 240} Pu Other
JANET							
11908110	Rattus rattus skin	10.7±16.4		0.916±23.3	3	515.3±0.4	
11909510	Rattus rattus kidney	26.1±19.5		2.60±17.3		655.9 ± 1.0	
11909610	<u>Rattus rattus</u> lungs	21.5±21.7			0.45±9.0	587.4±1.0	0.51±10.0
11911910	<u>Rattus</u> <u>rattus</u> skin	4,94 ±9 ,9				405.7 ±1. 8	
11912810	<u>Rattus</u> lungs	76.6±20.1	98.7±11.0		4.11±21.0	1272±1.4	
11914110	Rattus rattus kidney			5.78±21.2		821.6±1.5	
11914210	Rattus rattus Iungs				2.93±8.0	1069±1.0	
11914310	Rattus rattus kidney			4.94±15.1		467.1±1.1	
11914410	Rattus rattus kidney			2.63±22.1		274.7±1.3	
11914510	<u>Rattus</u> <u>rattus</u> lungs	48.3±23.7		0.55±13.0		308.1±1. 9	1.32±10.0
11914610	Rattus rattus kidney	62.3±26.6		6.0±18.5		838.3±1.6	
11914710	Rattus rattus Tungs	29.7±8.0		2.17±24.2	1.80±5.0	830.2±1.9	0.865±15.0
11924210	Rattus rattus muscle		26.2±2.0		3.13±3.0	886,9±1.7	0.0128±13.0

Radionuclide concentration levels, pCi/g ovendry wt (error, %)

Table 59 (continued).

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Radionuclide concentration levels, pCi/g ovendry wt (error, %)

Sample No.	Туре	40 _K	⁵⁵ Fe	⁶⁰ Co	⁹⁰ Sr	137Cs	239,240 _{Pu}	Other
КАТЕ								
10189211	Messerschmidia argentea leaves	9.62±6.5			3.75±1.0	4.26±2.1	0,0049±9,0	
10189311	<u>Scaevola</u> <u>frutescens</u> leaves	14.6±5.4				16.36±1.1		
10189411	Pisonia grandis Ieaves	9.59±6.7		3.85±3.4	23.60±1.0	221.1±0.3	0.0045±21.0	
10189511	Morinda citrifolia leaves	14.50±5.5			23.56±1.0	34.09±0.7		
11917811	Phaethon rubricauda viscera	7.81±13.0						
11921511	Phaethon rubricauda liver							
11923111	Phaethon rubricauda muscle	8.79±6.1						
11926311	Phaethon rubricauda bone					0,10128,0		⁶⁵ Zn (0,64±30,1)
LUCY								
10187112	Messerschmidia argentea Ieaves	10.73±6.2				6.36±1.7		155 _{Eu} (0, 05±44, 2)
10187212	Scaevola frutescens leaves	13.01±5.5				12.73±1.2		
11919312	<u>Anous stolidus</u> viscera	13.08±10.3	108.6±9.5					
11919412	Anous stolidus liver		199.1±2.0			0.187±11.0)	
11923212	Anous stolidus muscle	12.23±10.9	8.78±4.0				0.022±10.0	

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Radionuclide concentration levels, pCi/g ovendry wt (error, %)

Sample No.	Туре	40 _K	⁵⁵ Fe	⁶⁰ Co	⁹⁰ Sr	137 Cs	^{239, 240} Pu Other
LUCY							
11925112	Crab hepatopancreas and gonad	10.42±36.2		2.95±9.2		125.7±1.9	
11925212	Crab exoskeleton			0.967±10.9		39,15±1.3	
11926412	Anous stolidus		38.5±11.0		0.712±15.0	7.45±4.3	
MARY							
10244114	Morinda citrifolia leaves	16,27±6.9			45.05±1.0		0.034±13.0
10244214	Messerschmidia argentea leaves	13.24±5.4			7.57±1.9	7.12±1.6	
10244314	Scaevola frutescens leaves	16.14±4.4			16.76±1.1	12.77±1.0	
10244414	<u>Guettarda speciosa</u> leaves	7.70:t4.7			36,85±1.0	98.69±1.8	
10244514	Morinda citrifolia fruit	12.45±3.0			4.01±3.0	192.3±0.7	0.012±5.0
10329814	<u>Cocos</u> nucifera fruit	7.52±6.5	1.18±8.3		0.136±5.4	14.27±1.0	
10466714	<u>Morinda citrifolia</u> fruit	13.45±3.7		0.057±29.2	3.35±2.3	97.43±0.8	0.0022 ± 24.0
10466814	Lepturus repens Ieaves				17.39±1.0	105.7±0.9	0.0093 ± 11.0
11919514	Anous stolidus liver	6.626±27.0	2.51±2.0	0.567±18.5			
11921614	Anous stolidus viscera	11.41±24.6	53.60±1.8				

Table 59 (continued).

Radionuclide concentration levels, pCi/g ovendry wt (error, 3)

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Table 59 (continued).

Radionuclide concentration levels, pCi/g ovendry wt (error, %)

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Sample No.	Туре	40 _K	⁵⁵ Fe	⁶⁰ Co	90 _{Sr}	¹³⁷ Cs	239,240 _{Pu} Other
MARY							
11923314	Anous stolidus muscle	6.77±13.6	14.2±3.0	0.316±25.7	0.48±3.0		
11927514	Anous stolidus bone	5.74±13.3	59.9±2.7				
10930714	<u>Cocos nucifera</u> fruit	39.25±8.3			0.635±100	67.75±1.4	
10930814	<u>Cocos</u> <u>nucifera</u> fruit	3.80±6.1	76,58±9.5		14.14±9.6	5.59±1.5	
NANCY							
10243615	<u>Guettarda</u> <u>speciosa</u> leaves	8.79±5.4			30.86±1.0	8.73±1.4	0.0097±28.0
10243715	<u>Pisonia grandis</u> leaves	16.51 ±4 .4		0.237±14.0	0 36.67±1.0	43.87±1.0	0.0195±14.0
10243815	<u>Scaevola</u> <u>frutescens</u> leaves	10.74 ± 4.2	0.05 ± 17		11.89±1.0	4.12±1.7	0.0125±16.0
10243915	Morinda citrifolia	11.16±4.0			43.47±1.0	55,0510.9	$0,0056\pm 26,0$
10329915	<u>Cocos nucifera</u> fruit	6.54±6.9	1.95±6.3		0.167±6.4		18.83+0.8 ³ H (0.333±6.3)
10371215	Messerschmidia argentea leaves	7.81±7.6			27.30±1.0	40.24±0.7	0.023±12.0
10930915	<u>Cocos</u> <u>nucifera</u> fruit	73.51±17.9	5,95±16.0		1.15+11.0	148,814.0	
OLIVE				:			
10244616	<u>Morinda</u> citrifolia fruit	18.74 ±4 .0			4.48±2.0	30.42±0.7	

Radionuclide concentration levels, pCi/g ovendry wt (error, %)

Sample No.	Туре	⁴⁰ K	⁵⁵ Fe	⁶⁰ Co	90 _{Sr}	¹³⁷ Cs	239,240 _{Pu}	Other
OLIVE								100
10244716	Morinda citrifolia Ieaves	12.48±5.5	0.063±18	0.33±17.4	37.66±1.0	66.58±0. 5	0.011±12	¹⁵² Eu (0,13±43,1)
10244816	Morinda citrifolia leaves	18.73±4.4			39,50±1,0	29.57±0.7	0.0036±25.0	
10244916	<u>Messerschmidia</u> argentea Ieaves	10.73±5.4				9.54±1.2		
10330016	<u>Scaevola</u> frutescens leaves	13.30± 5.5				4.35±2.1		
11919616	Anous stolidus liver		332.4±2.0		0.036±16.0		0.010±20.0	
11921716	Anous stolidus viscera	8.81±16.3	57.21±2.4					
11923416	Anous stolidus muscle	7.69±13.5	92.8±2.0				0.092±8.0	
11927616	Anous stolidus bone	4.07±21.9	46.40±3.4	0.31±16.7	0.39±13.0			
PEARL								
10224517	Scaevola frutescens leaves	16. 50± 4. 6			0.348±8.2	0.342±103	0.0023±19.0	
10224617	<u>Messerschmidia</u> argentea leaves	14,66±8.0			0.473±5.7	0.295±26.6		
10245417	<u>Scaevola frutescens</u> leaves	12,52±5,2		0.159±28.6	20.99±1.4	30,82±0,7	0.0031±2.7	
11909717	Rattus exulans liver	32,33±12,7	82.0±5.0	5.07±7.7	1 64.9 0 ±6.0	33,30±2,7	0,0119±8,0	
11913117	Rattus exulans viscera			7.45±2.9	1.79±4.0	30.80±1.3	1,7748.0	

Table 59 (continued).

Radionuclide concentration levels, pCi/g ovendry wt (error, 7)

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	liver							
11913117	<u>Rattus exulans</u> viscera			7.45±2.9	1.79±4.0	30.80±1.3	1.77±8.0	
						; 	A Action and a starting of	
	Table 59 (continued).	Radionuclic	le concentra	tion levels,	pCi/g ovend	ry wt (error	(γ, γ_n)	
Sample No.	Туре	40 _K	⁵⁵ Fe	⁶⁰ Co	⁹⁰ Sr	137Cs	239,240 Pu Other	
PEARL								
11908217	Rattus exulans skin	8.4±16.2		1.58±12.7		15.0±2.3		
11909817	<u>Rattus</u> <u>exulans</u> kidney	51.5±29.5		5,46±17.6		27.9±5.5		
11910517	<u>Rattus</u> exulans lungs				0.84±28.0	51.22±3.7	8.15±6.0	
11919717	Terns liver		317.1±2.0	0.65±26.5				
11921817	Terns, pooled viscera		61.71±2.7	0.435±27.2				
11923517	Terns, pooled muscle	8.67±13.5		0,659±20,0				
11924917	Rattus exulans muscle	11.60±12.4	23.2±8. 0	0.888±10.60	0.037±11.0	37.07±1.4	0.117±13.0	
11925017	Rattus exulans bone	9.57±34.1		2.59±10.3	36.1±4 . 0	53.60±1.4		
11927717	Terns, pooled bone		46.9±5.4			0,793±16,9		
DIDV								
10225118	<u>Messerschmidia</u> argentea leaves	9.19±11.6		0,995±10,3		19.19±2.0		
10225318	<u>Messerschmidia</u> argentea leaves	6.23±5.7		0.905±3.4		39.01±1.7		
SALLY								
10188019	Pandanus tectorius leaves	14.02±10.3	0.703±2.0		1.97±2.0	14,98±2,1	0.015±13.0	

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		Radionuclio	le concentra	ation levels,	pCi/g oven	d r y wt (erro	r, %)	
Sample No.	Туре	40 _K	55 _{Fe}	60 _{Co}	90 _{Sr}	137 _{Cs}	239,240 _{Pu}	Other
SALLY								
10188119	Lepturus repens leaves	3.74±15.9			1.98±1.8	83.20±0.9	0.0227±16.0	-
10188219	<u>Messerschmidia</u> argentea leaves	8.28±5.2		0.10±17.4	4.86±1.4	12.63±1.0	0.059±6.7	²³⁸ Pu (0.0022±17.0)
10188319	<u>Scaevola frutescens</u> leaves	10. 78±6.5			6.67±1.4	13.38 ± 1.3	0.096±14.0	²³⁸ Pu (0.0027±26.0)
11900219	<u>Sterna fuscata</u> eggshell				0.265±13.0	•	0.005±26	
11901619	<u>Sterna fuscata</u> egg	4.57±11.1	37.57±2.0		0,0042±19,0		0.015±4.0	
11906919	Rattus exulans viscera	9.63±9.0		1.48±9.6	14.6±1.0	9 2,97±0, 5	1.30±4.0	
11911419	Rattus exulans liver	10.73±12.3	35.5±4.0	2. 54 ±6. 3	0.0021±22.0	63.83±1.2	0,008±15.0	
11915819	Rattus exulans muscle	5.82±17.6				60.86±0.9		³ H (18.7±1.3)
11917917	<u>Sterna fuscata</u> viscera	4.79±22,40	22.43±5.1					
11919819	<u>Sterna</u> <u>fuscata</u> liver		155.0±3.0					
11919919	Anous tenui liver						0.011±19	
11921919	Anous tenui viscera	5.89±17.30	64.4±1.0					
11923619	Anous tenui muscle	6.31±11.50	36.6±2.0				0.005±11	
11923819	Rattus exulans bone	7.01±15.0		0.81±15.3	25.9±2.0	65.77±0.7	0.039±15.0	

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Radionuclide concentration levels, pCi/g ovendry wt (error, %)

Sample No.	Туре	⁴⁰ K	⁵⁵ Fe	⁶⁰ Co	⁹⁰ Sr	¹³⁷ Cs	239,240 _{Pu} Other
SALLY							
11908319	Rattus exulans skin	4.52±11.9		0.49±16.0		49.1±0.6	
11926519	Sooty tern bone		61.3±4.5	0.34 ± 14.1	1.68±7.6	0.14 ± 27.0	
11927819	Sooty tern bone		35.7±4.7				
11913219	<u>Rattus exulans</u> lungs	13.2±21.4		0.67±23.9	0.22±11.0	73.9±1.8	0.198±6.0
11914819	Rattus exulans kidney			2.28±14.2		$73.3{\pm}1.4$	
11923719	Noddy tern muscle	7.63±10.8	109.5±2.0		0.014±18.0		0.020±8.0
TILDA							
10330420	<u>Guettarda speciosa</u> leaves	10.10±5.2			12.57±1.0	5.90 ± 1.4	0.0091 ± 19.0
10330520	Pandanus tectorius leaves	13.29±7.2	2.94 ± 5.0		15.50 ± 2.0	152.2±0.4	0.0069 ± 18.0
10330620	<u>Scaevola</u> frutescens leaves	11.39±5.7			9.05±1.7	24.94±0.8	0.0042 ± 25.0
10330720	<u>Morinda</u> citrifolia leaves	13.94±5.1			12.48±1.1	13.90 ± 1.1	
10330820	<u>Messerschmidia</u> argentea leaves	10.13±5.7			10.27±1.5	58,78±1.9	
URSULA							
10187521	<u>Messerschmidia</u> argentea leaves	10.09±3.7			13.60±1.0	104.9 ± 1.7	

Radionuclide concentration levels, pCi/g ovendry wt (error, %)

Sample No.	Туре	⁴⁰ K	⁵⁵ Fe	⁶⁰ Co	$90_{ m Sr}$	137 Cs	²³⁹ , ²⁴⁰ Pu Other
URSULA				·····			
10187621	<u>Scaevola</u> <u>frutescens</u> Ieaves	5.45 ± 10.7			6.13 ± 1.0	91.49±0.8	0.0031 ± 11.0
10187721	<u>Scaevola</u> frutescens leaves	13.47±9.4				0.293±29.1	
10187821	Guettarda speciosa Ieaves	14.23±9.0			7.30±1.2	13.27 ± 2.0	
11907021	Rattus exulans viscera	10.87±12.5		1.13±18.5	2.17 ± 1.9	43.14±1.1	0.29±3.0
11913321	Rattus exulans liver	6.72±31.7	42.2±5.0	3.59±6 . 2		39.41±3.1	$0.041\pm9.0 = \frac{207}{0.375\pm29.9}$
11908421	Rattus exulans Skin	7.58±11.3		0.41±21.6		18.5±1.4	
11914921	Rattus exulans kidney					38.4±6.6	
11915021	Rattus exulans lungs					45.0±3.0	
11915921	Rattus exulans muscle	9.22±18.6				37.86±1.3	
11916621	Rattus exulans bone	7.26±25.0			19.6±4.0	61,58±1.2	0.146±9.0
VERA							
10225822	<u>Messerschmidia</u> argentea leaves	7.07±6.5			12.79±1.4	10.77 ± 1.1	0.0024 ± 19.0
10225922	<u>Scaevola frutescens</u> leaves	8.18±6.4			4.49±1.7	1.686±3.4	
10226022	Morinda citrifolia leaves	10.46±6.8			11.85±2.5	$12.12{\pm}1.4$	
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Radionuclide concentration levels, pCi/g ovendry wt (error, %)

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	Table 59 (continued).							
		Radionucli	de concentra	tion levels,	pCi/g_ovend	ry wt (erroi	<u>(, ()</u>	
Sample No.	Туре	40 _K	⁵⁵ Fe	⁶⁰ Co	⁹⁰ Sr	¹³⁷ Cs	239,240 _{Pu}	Other
URSULA								
10226122	<u>Pisonia grandis</u> Ieaves	28.58±4.8			23.11±1.1	56,94 ±1,0		
10226222	Pandanus tectorius	9.171±8.8			4.24±2.8	17.58 ± 1.5	0.0076±15.0)
10245622	Cocos nucifera fruit	5.64±7.6			0.134±6.0	9,297±1,2		
WILMA								
10224823	<u>Messerschmidia</u> argentea leaves	5.00±11.0				6.19±2.9		
10224923	<u>Scaevola</u> <u>frutescens</u> leaves	10.31±6.8				1.245±3.7		
10225023	<u>Guettarda speciosa</u> Ieaves	10.60±4.3				3.14±1.9		
Y VONNE								
10327224	Scaevola frutescens Teaves	13.2±5.4		0.511±11.8	1.76±1.6	11,88±1,2	0 ,0265±20,0	238 _{Pu} (0,0068±32,0)
10327324	Scaevola frutescens	14.16 ± 5.3			0.442±5.4	1.575 ± 3.7	0.0042±3.9	
10327424	Messerschmidia argentea leaves	14.19±5.8			0.6396±5.9	2.28 ± 3.3	0.0036 ± 5.1	
10327524	Scaevola frutescens	15.0±5.1		0.246±22.3	0.662±4.9	8.06±1.5	1.293±5.0	²³⁸ Pu (0.061±9.7), ²⁴¹ Am (0.146±5.0)
10327624	<u>Scaevola frutescens</u>	10.68±6.3		20.26 ± 1.4	159.0 ± 1.0	609,9±0,2	0.323 ± 5.0	
10327724	Guettarda speciosa	11.15±5.9		4.52±3.2	64.4±1.0	795.0±0.1	0.0253±1.8	
10327824	Messerschmidia argentea	14.46 ± 5.7			1,428±3.9	3.81±2.4	0.0108±2.9	

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		Radionucli	de concentr	ation levels,	pCi/g oven	dry wt (erro	or, %)	
Sample No.	Туре	⁴⁰ K	⁵⁵ Fe	⁶⁰ Co	90 _{Sr}	¹³⁷ Cs	239,240 _{Pu}	Other
YVONNE								
10327924	Messerschmidia argentea	10.91±5.6			8.6±2.0	95,3±0,4	0.129±3.0	
10328024	<u>Scaevola</u> frutescens	15.9 3± 4.3			1.94 ± 1.4	28.25±0.7	0.19±5.4	238 _{Pu} (0.076±9.0)
10330124	Scaevola frutescens	18.77 ± 4.1		6.26 ± 2.5	80.63±1.0	658.0±0.1	0,196±2,0	
10330224	Messerschmidia argentea	10.33±7.0			1.941±3.4	17.30±1.1	0.766±1.0	
10330324	Messerschmidia argentea	9.928±6.0		1.16 ± 7.7	257.2±1.0	5644.0±0.0	0.114 ± 6.0	
10371024	<u>Cocos</u> <u>nucifera</u> fruit	6.392±7.2				$1,986\pm 2.8$		
10371124	<u>Cocos</u> <u>nucifera</u> fruit	8.243±5.8			0.011±5.0	3.96 ± 1.8		³ H (0.66±8.3)
11900824	Anous stolidus eggshell		1.10±27.0		0.22±18.0			
11900924	Anous stolidus eggshell						0.0086±17.0	I Contraction of the second
11901724	Anous stolidus egg	4.53±15.5			1.06 ± 6.0			
11901824	Anous stolidus egg	4.129±17.2	56.76 ± 2.0				0.0232±6.0	
11901924	Anous stolidus egg	7.221±9.3	54.5±2.0		0.073±11.0	0.079±46.0		
11906724	Rattus rattus viscera	13.33±8.2		230.0±0.5	4.09±2.0	3531,0±0,1	0.58±3.0	
11907124	<u>Rattus rattus</u> viscera	9.667±12.6		1.99±10.7	0.57±5.0	76.7±0.8	0.393±3.0	
11909924	Rattus rattus liver		126.1±3.0	70.3±3.2		2559 .0±0 .9	0.0271±12.0	151 _{Sm} (18.7±3.0)
11911524	Rattus rattus	14.15±14.8	135.6±2.0	86.13±1.5	0.0046±7.0	2215.0±0.7	0.0129±13.0	

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Radionuclide concentration levels, pCi/g ovendry wt (error, "6)

Sample No.	Туре	⁴⁰ К	⁵⁵ Fe	⁶⁰ Co	⁹⁰ Sr	137 Cs	239,240 Pu	Other
YVONNE								
11911624	<u>Rattus rattus</u> viscera		3.46±18.0	4.186 ± 3.7	0.327 ± 19.0	55.8 ± 1.4	0.211±7.2	²³⁸ Pu (0.0964±8.3)
11911724	<u>Rattus rattus</u> viscera	17.77±14.4			0.20.110.0	5,745.7	0.0206 ± 11.0	I
11911824	<u>Rattus</u> viscera	7.608±15.4		112.6±0. 9		2928.0±1.8	1.05±3.0	$rac{134}{(1.9\pm19.2)}$
11913624	Rattus rattus		25.1±2.0	2.9±6.5		56,2± 1 ,7	0.0078±24.0	$\frac{151}{\text{Sm}}$ (23.0±3.0)
11913724	Rattus liver		13.8±18.0	5.63±7.9	0.0024 ± 27.4	038.7±2.7	0.011±26.0	
14945424	Rattus rattus liver		17,348,0		10,5432-0	4.62115.0	0.039818.0	
11916024	<u>Rattus rattus</u> muscle	12.35±15.7	32.8±3.0	12.83±4.5	5.09±4.0	4240,0±0,1	0.052±9.0	³ H (1.8±2.3)
11916124	<u>Rattus rattus</u> muscle	13.07±7.3	78.8±2.0	8.51 ± 2.9	37.8±1.0	3824.0±0.1		
11916224	<u>Rattus rattus</u> muscle	16.82±9.9				86.0±0.9		
11916724	Rattus rattus bone			5.92±2.8	146.4 ± 1.0	1833.0±0.7		$\frac{134}{(1.12\pm18.8)}$
11916824	Rattus rattus bone	7,932±12.2		10.57±3.7	135.1±1.0	2200.0±0.7	0,29±5.0	$\frac{134}{Cs}$ (1.36±13.9)
11916924	Rattus rattus bone	9.739±12.2		0.327±28.0	16.7 ± 2.0	48.8±1.2	0.304±11.0	
11918024	Anous stolidus viscera	8.338±24.3	64.4±3.6	0.51±35.3				
11920024	Anous stolidus liver		385.6±2.0	0.37±25.8				

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		Radionucli	de concentra	ation levels,	pCi/g oven	dry wt (erro	or, %)
Sample No.	Туре	⁴⁰ K	⁵⁵ Fe	⁶⁰ Co	⁹⁰ Sr	¹³⁷ Cs	^{239, 240} Pu Other
YVONNE							
11923924	Anous stolidus muscle	7.387±11.1	22.6 ± 2.0	0.23±36.6	0.0073±28.	0	0.020±37.0
11924324	Rattus rattus muscle	5.77 ± 25.3	4.1±6.0	0.554 ± 24.9	6.76±5.0	49.2±1.7	³ H (1,1±5.6)
11924424	Rattus rattus muscle	15.87±6.8	1.23±22.0		0.631±3.0	3.74 ± 3.1	0.0077 ± 21.0
11925324	<u>Rattus</u> bone	23.95±13.7			1.32±8.0	23.8±3.0	0.059 ± 15.0
11925424	Rattus rattus bone			0.514 ± 9.7	6.40±13.0	38.78±1.1	0.059±11.0
11926624	Anous stolidus bone		63.5±1.0			5.51±4.8	0.021 ± 26.0
11908924	Rattus rattus skin	10.7±19.9				3.94±7.0	
11900624	Anous tenuirostris eggs						
11908624	Rattus rattus skin	6.92±18.4		7.43±4.0		1875±0.1	
11908724	<u>Rattus rattus</u> skin	4.74±21.0		·		4 2.6± 0 .9	
11908524	<u>Rattus</u> rattus skin	6.7±10.9		14.0±2.2		2088±0.1	
11908824	Rattus rattus skin			0.69±22.3		28.4±1.2	
11910024	Rattus rattus kidney			257.7±2.9		3427±1.8	
11910124	<u>Rattus</u> Tungs	33.1±14.2	252.3±2.4	11.1±5.2	16.2±6.4	2760±0.8	

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Table 59 (continued).

Radionuclide concentration levels, pCi/g ovendry wt (error, "a)

11.1±0.2

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10.2±6.4

 $2760 \pm 0.8$ 

1.35

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| Sample No. | Туре                           | 40 <sub>K</sub>  | <sup>55</sup> Fe | <sup>60</sup> Co | 90 <sub>Sr</sub> | <sup>137</sup> Cs | 239,240 <sub>Pu</sub> | Other                      |
|------------|--------------------------------|------------------|------------------|------------------|------------------|-------------------|-----------------------|----------------------------|
| YVONNE     |                                |                  |                  |                  |                  |                   |                       |                            |
| 11910224   | <u>Rattus rattus</u><br>Iungs  |                  |                  |                  |                  | 53.3±3.9          | $0.57 \pm 15.0$       |                            |
| 11910324   | <u>Rattus rattus</u><br>kidney | 167.2±17         |                  |                  |                  | 6,19123,4         |                       |                            |
| 11910424   | <u>Rattus rattus</u><br>lungs  |                  |                  |                  |                  | $11.6 \pm 19.3$   | $0.20\pm24.0$         |                            |
| 11913424   | Rattus rattus<br>kidney        |                  |                  | 261.8±1.1        |                  | 3286±1.0          |                       |                            |
| 11913524   | <u>Rattus rattus</u><br>Iungs  | 14.3±28.7        |                  | 10.5±6.1         | $0.24 \pm 11.0$  | 3306±1.7          | 0.11±9.0              | $\frac{134}{(1.5\pm28.5)}$ |
| 11915124   | Rattus rattus<br>kidney        |                  |                  | 4.96±17.1        |                  | 59.6±3.7          |                       |                            |
| 11915224   | <u>Rattus rattus</u><br>Iungs  |                  |                  |                  |                  | 39.7±3.4          | 0.023±34.0            |                            |
| 11915324   | Rattus rattus<br>kidney        | 30.64±24.2       |                  | 8.03±7.3         |                  | 29.0±3.5          |                       |                            |
| ALVIN      |                                |                  |                  |                  |                  |                   |                       |                            |
| 10156130   | Messerschmidia argentea        | $11,57 \pm 10.4$ |                  |                  |                  | $0.846 \pm 10.1$  |                       |                            |
| 11918330   | Terns,<br>pooled liver         | 20.37±10.7       |                  |                  |                  |                   |                       |                            |
| 11922030   | Terns,<br>pooled muscle        | $10.44 \pm 12.0$ |                  |                  |                  |                   |                       |                            |
| 11925630   | Terns,<br>pooled bone          | 10.32±15.1       |                  |                  |                  | 5.71 <b>t4.8</b>  |                       |                            |
| TOM        |                                |                  |                  |                  |                  |                   |                       |                            |
| 10187027   | Messerschmidia argentea        | 9.16±4.9         |                  |                  |                  | 0.26±8.0          |                       |                            |

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|            |                                | Radionuclio     | de concentra     | ation levels,    | pCi/g over       | ndry wt (erro                          | $r, \frac{07}{10}$          |
|------------|--------------------------------|-----------------|------------------|------------------|------------------|----------------------------------------|-----------------------------|
| Sample No. | Туре                           | 40 <sub>K</sub> | <sup>55</sup> Fe | <sup>60</sup> Co | 90 <sub>Sr</sub> | $^{137}$ Cs                            | 239,240 <sub>Pu</sub> Other |
| ТОМ        |                                |                 |                  |                  |                  |                                        |                             |
| 10155327   | <u>Scaevola</u> frutescens     | 11.5±3.7        |                  |                  |                  | 0.74±4.0                               | -                           |
| URIAH      |                                |                 |                  |                  |                  |                                        |                             |
| 10155428   | Messerschmidia argentea        | 11.9±12.5       |                  |                  |                  | 0.73±10.0                              |                             |
| VAN        |                                |                 |                  |                  |                  |                                        |                             |
| 10155529   | Messerschmidia argentea        | 6.81±8.0        |                  |                  |                  | $0.35 \pm 10.7$                        |                             |
| 10155729   | Pisonia grandis                | 12.9±5.3        |                  | 0.17±28.2        |                  | 1,99±3,2                               |                             |
| 10155629   | Scaevola frutescens            | 7.11±7.9        |                  |                  |                  | 0,73±6,3                               |                             |
| 11925929   | Anous stolidus<br>bone         | 6.96±20.2       | 40.3±1.6         |                  | 0.14±3.0         | 0.74±2.4                               |                             |
| 11900429   | Anous stolidus<br>egg shell    |                 | 1.68±17.0        |                  |                  |                                        |                             |
| 11902029   | Anous stolidus<br>egg          | 6.31±10.8       | 63.5±2.0         |                  |                  | $0.14 \pm 30.7$                        | $0.0004 \pm 29.0$           |
| 11917229   | Anous stolidus<br>muscle       | 10.5±8.2        | 99.55±2.0        | 0,29±26.7        |                  |                                        | $0.0014\pm 20.0$            |
| 11918929   | <u>Anous stolidus</u><br>liver |                 | 278.9±2.0        | 0.19±33          | $0.04 \pm 8.0$   |                                        |                             |
| 11921129   | Anous stolidus<br>viscera      |                 | 50.5±1.6         |                  |                  |                                        |                             |
| BRUCE      |                                |                 |                  |                  |                  |                                        |                             |
| 10156931   | Cocos nucifera                 | 5.93±7.1        |                  |                  |                  | 0.582±5.6                              |                             |
| 10186731   | Messerschmidia argentea        | 8.027±6.3       |                  |                  | 0.328±5.3        | 1.158±4.0                              |                             |
| 10186831   | Scaevola frutescens            | 9.32±5.5        |                  |                  | 0.878±2.5        | 0,751±5.5                              |                             |
|            |                                |                 |                  |                  |                  | ······································ |                             |

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Table 59 (continued).

Radionuclide concentration levels, pCi/g ovendry wt (error,  $\frac{77}{70}$ )

| Sample No. | Туре                                                   | <sup>40</sup> K | $55_{\rm Fe}$   | <sup>60</sup> Co | <sup>90</sup> Sr | 137 Cs            | 239,240 <sub>Pu</sub> | Other                    |
|------------|--------------------------------------------------------|-----------------|-----------------|------------------|------------------|-------------------|-----------------------|--------------------------|
| BRUCE      |                                                        |                 |                 |                  |                  |                   |                       |                          |
| 10186931   | Pisonia grandis                                        | $17.76 \pm 2.8$ |                 |                  | 0.50±4.0         | $1.456\pm2.6$     |                       | 0                        |
| 11903931   | Birgus latro<br>muscle                                 | 11.28±6.4       | 0.98±37.0       | 0.20±27.3        | 0.185±6.0        | 1.978±3 5         |                       | ${}^{3}$ H<br>(0.42±5.2) |
| 11918431   | Anous tenuirostris<br>liver                            | 8.369±28.5      | $326.6\pm2.0$   |                  |                  |                   |                       |                          |
| 11922131   | Anous tenuirostris<br>muscle                           | 7.095±12.4      | 41.3±2.0        | 0.392±19.9       |                  |                   | 0.0069±8.0            |                          |
| 11924531   | <u>Rattus rattus</u><br>bone                           | 18.81±12.0      |                 |                  | 1.69±4.0         | 13.25±3.1         | 3.279±4.0             |                          |
| 11925731   | Anous tenuirostris<br>bone                             |                 | 44.2±1.3        |                  | $0.66 \pm 12.0$  |                   |                       |                          |
| 11904031   | Birgus latro<br>exoskeleton                            | $2.59 \pm 10.4$ | $0.07 \pm 28.0$ |                  | 6.08±3.0         | $0,287\pm\!\!8,1$ | 0.001±4.0             |                          |
| 11904131   | Birgus latro<br>hepatopancreas<br>and gonad            | 3.018±10.4      | 5.7±3.0         | 0.402±10.4       | 0.133±2.0        | 0.42±7.1          |                       | ${}^{3}$ H<br>(0.16±2.4) |
| 11909031   | Rattus rattus<br>liver                                 | 30.2117.0       | 46.417.0        | $1.617 \pm 23.5$ |                  | 1.07132.6         | 0.013+11.0            |                          |
| 11912231   | <u>Rattus rattus</u><br>viscera                        |                 |                 |                  |                  | $1.09 \pm 132.0$  | 0.035±12.0            |                          |
| 11915531   | <u>Rattus rattus</u><br>muscle                         | 5.207±38.6      | 2.21±16.0       |                  | $0.074 \pm 9.0$  | $1.472\pm12.8$    | 0,0086±13.0           | )                        |
| 11904231   | <u>Birgus latro</u><br>skin, gills, green gland        | 7.25±17.7       |                 |                  |                  | <b>1.68±8.6</b>   |                       |                          |
| 11904331   | <u>Birgus latro</u><br>shell, gill, dust,<br>gut blood | 6.15±14.5       |                 |                  |                  | 1.3417.4          |                       |                          |
| 11907531   | <u>Rattus</u> rattus<br>hide                           | 8.07±18.7       |                 |                  |                  | 0.61±23.1         |                       |                          |

|            |                                     | Radionucli          | de concentra     | ation levels,    | , pCi/g oven                           | dry wt (erro | or, %)                          |
|------------|-------------------------------------|---------------------|------------------|------------------|----------------------------------------|--------------|---------------------------------|
| Sample No. | Туре                                | <sup>40</sup> к     | <sup>55</sup> Fe | <sup>60</sup> Co | 90 <sub>Sr</sub>                       | 137('s       | 239,240 Pu Other                |
| BRUCE      |                                     |                     | ·····            | ******           |                                        |              |                                 |
| 11909131   | Rattus rattus<br>kidney             |                     |                  | 3.19±20.5        |                                        |              |                                 |
| 11913831   | Rattus rattus<br>Iungs              | 35.9±34.3           |                  |                  |                                        |              |                                 |
| 11920331   | Anous tenuirostris<br>viscera       |                     | 73.9±1.1         |                  |                                        |              |                                 |
| CLYDE      |                                     |                     |                  |                  |                                        |              |                                 |
| 10155932   | Messerschmidia argentea             | 10.9±5.7            |                  |                  |                                        | 0.426±8.3    |                                 |
| 10156032   | Scaevola frutescens                 | 11.19±5.7           |                  |                  |                                        | 0,273±12,9   |                                 |
| 11900132   | Sterna fuscata eggshells            | 1.365 <b>±13</b> .0 |                  |                  |                                        |              |                                 |
| 11901132   | Sterna fuscata eggs                 | 5.41±9.8            |                  |                  |                                        |              |                                 |
| 11920432   | <u>Sterna fuscata</u> viscera       | 7.937±13.0          | 49.1±4.9         |                  |                                        |              |                                 |
| 11920532   | Sterna fuscata liver                |                     | 146.4±2.0        |                  | 0,015±8,0                              |              | $0.0017 \pm 29.0$               |
| 11922432   | <u>Sterna</u> <u>fuscata</u> muscle | 7.374±8.7           | 20.4±2.0         |                  | $0.00635 \pm 17$                       | .0           |                                 |
| 11925832   | Sterna fuscata bone                 | 2.36±36.0           | 36.0±12.0        |                  |                                        |              |                                 |
| DAVID      |                                     |                     |                  |                  |                                        |              |                                 |
| 10019933   | Messerschmidia argentea             | 13.55±5.1           |                  |                  | 0.464 ±4.8                             | 1.086±4.3    | $0.0061 \pm 22.0$               |
| 10020533   | Tacca leontopetaloides              | 6.635±9.8           |                  |                  | 0.096±3.0                              | 8.60±1.5     | $0.0011\pm32.0^{3}$ H(0.52±4.9) |
| 10020633   | Cocos nucifera                      | 6.441±8.1           |                  |                  | 0.01387±6.0                            | 2,593±2,5    | $^{3}$ H(0, 31 + 13, 7)         |
| 10020833   | <u>Scaevola frutescens</u>          | 17.59±4.8           |                  |                  | 0.341±7.4                              | 1.114±4.7    | 0.0005±5.7                      |
| 10021133   | Pisonia grandis                     | 19.02±4.7           |                  |                  | 0.77±3.1                               | 3.118±2.6    | 0.0013±25.0                     |
| 10020033   | <u>Pisonia</u> grandis              | 10.2±6.6            |                  |                  | 0.56±6.2                               | 1.80±3.4     | 0.0002±9.8                      |
| 10021333   | Cocos nucifera                      | 3.761±14.4          |                  |                  | 0.1784±6.8                             | 1688±4.0     | 102 <sub>Rh</sub>               |
|            |                                     |                     |                  |                  | ······································ |              | (0, 1234 + 26, 2)               |

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(0,1234+26,2)

Table 59 (continued).

Radionuclide concentration levels, pCi/g ovendry wt (error, %)

| Sample No. | Туре                                     | 40 <sub>K</sub>  | <sup>55</sup> Fe | <sup>60</sup> Co | <sup>90</sup> Sr  | 137Cs                             | 239,240 <sub>Pu</sub> | Other                        |
|------------|------------------------------------------|------------------|------------------|------------------|-------------------|-----------------------------------|-----------------------|------------------------------|
| DAVID      |                                          |                  |                  |                  |                   |                                   |                       |                              |
| 10022633   | Morinda citrifolia                       | 12,59±3.7        |                  |                  | 0.0251±4.0        | 3,84 ±1,5                         | 0.0127±6.00           |                              |
| 10370333   | Pandanus tectorius                       | $9.74 \pm 7.9$   | 0.13±19.0        |                  | $3.56 \pm 1.0$    | $15.9{\pm}1.2$                    |                       |                              |
| 10370433   | Scaevola frutescens                      | 10.69±5.1        |                  |                  | 0.3716±5.2        | $4.82 \pm 1.6$                    |                       |                              |
| 10371333   | Messerschmidia argentea                  | 11.02±5.1        |                  |                  | 0.757±8.0         | $7.243 \pm 1.3$                   |                       |                              |
| 10371433   | Pisonia grandis                          | 18.10±3.6        |                  |                  | 0.608±4.3         | 1,677±2,9                         |                       |                              |
| 10371533   | Guettarda speciosa                       | $3.996 \pm 11.1$ |                  |                  | <b>0</b> ,322±7,6 | $3,157\pm 2,5$                    |                       |                              |
| 10412033   | Fimbrystilis atollensis<br>sedge         | 3.383±22.3       |                  |                  |                   | 7.396±2.1                         |                       |                              |
| 10412133   | Cocos nucifera                           | 4.694±6.6        |                  |                  | 0.0263±10.0       | 0,399±5,9                         | 0,00343±5.0           |                              |
| 10412233   | Scaevola frutescens                      | 13.02±9.2        |                  |                  | $0.314 \pm 7.6$   | 5.18±3.2                          |                       |                              |
| 10412433   | Messerschmidia argentea                  | $13.22 \pm 5.3$  |                  |                  | 1.059±5.3         | $2.581 \pm 3.4$                   |                       |                              |
| 10412333   | Scaevola frutescens                      | $16.33 \pm 9.4$  |                  |                  | 0.5586±6.6        | 2.014±7.0                         |                       |                              |
| 10412533   | Messerschmidia argentea                  | $3.882 \pm 16.3$ |                  |                  | 0.748±6.8         | $15,84 \pm 1,3$                   |                       |                              |
| 11902133   | Coenobita perlatus<br>hepatopancreas     | 7.613±9.6        | $0.57 \pm 34.0$  | 0.23±28.8        | 0,191±8,0         | <b>1</b> , 94 6 <del>±</del> 4, 3 | 4,82±33.0             | <sup>3</sup> H<br>(0,95±6-1) |
|            | and gonad                                |                  |                  |                  |                   |                                   |                       | 3                            |
| 11902933   | <u>Coenobita perlatus</u><br>muscle      | 7.518±8.2        |                  | 0.284 ±19.5      | 0,366+3,0         | 2,064 ±3,5                        | 0,0031±8,0            | 11<br>(0.58+3.5)             |
| 11903033   | <u>Coenobita perlatus</u><br>exoskeleton | $1.764 \pm 12.8$ | 0.039±37.0       |                  | 4.05±3.0          | 0.601±4.2                         | 0,010±6,0             |                              |
| 10931133   | Cocos nucifera<br>milk                   | 30.93±8.4        |                  |                  |                   | 23.32±2.0                         |                       |                              |
| 11924133   | <u>Sterna fuscata</u><br>muscle          | 7.459±20.1       | 59.0±2.0         |                  |                   |                                   | 0.119±30.0            |                              |
| 11924733   | <u>Erolia cuminata</u><br>liver          | 17.57±32.1       |                  |                  |                   |                                   |                       |                              |

Radionuclide concentration levels, pCi/g ovendry wt (error, %)

| Sample No. | Туре                                   | <sup>40</sup> K | <sup>55</sup> Fe | <sup>60</sup> Co | 90 <sub>Sr</sub> | <sup>137</sup> Cs | 239,240 <sub>Pu</sub> | Other        |
|------------|----------------------------------------|-----------------|------------------|------------------|------------------|-------------------|-----------------------|--------------|
| DAVID      |                                        |                 |                  |                  |                  |                   |                       |              |
| 11925533   | <u>Demigretta sacra</u><br>bone        | 8.761±13.0      |                  | 0.41±16.0        |                  |                   |                       |              |
| 11926733   | <u>Erolia</u> <u>cuminata</u><br>bone  | 28.16±8.5       |                  |                  |                  | 0.789±19.5        |                       |              |
| 11926833   | <u>Demigretta</u> <u>sacra</u><br>bone |                 |                  |                  |                  | 1.34±6.9          |                       | 101          |
| 11926933   | <u>Sterna</u> <u>fuscata</u><br>bone   |                 | $37.4 \pm 9.2$   |                  |                  | 0.745111,3        |                       | $^{1.34}$ (s |
| 11906233   | Rattus exulans<br>viscera              | 12.24±7.1       |                  |                  | 0.24±6.0         | 21.97±0.9         | 0.0087±9.0            |              |
| 11910633   | Rattus exulans<br>liver                |                 | $3.67 \pm 6.0$   |                  |                  | 16.36±2.4         | 0.00424±18            | . 0          |
| 11918533   | Sterna <u>fuscata</u><br>Iiver         | 20.36±16.0      | 153.2±3.0        |                  |                  |                   |                       |              |
| 11922233   | Rattus exulans<br>muscle               | 7.802±17.2      | 0.98±12.0        |                  | 0.604±6.0        | 18.78±1.6         | $0.044\pm7.0$         |              |
| 11922333   | Rattus exulans<br>bone                 | 11.46±13.0      |                  |                  | $1.37 \pm 2.0$   | 28.37±1.3         | 0.065±10.0            |              |
| 11924033   | Demigretta sacra<br>muscle             | 4.653±38.0      | )                |                  |                  | $1.59 \pm 10.5$   |                       |              |
| 10020033   | Pisonia grandis                        | 10.2±6.6        |                  |                  | $0.56 \pm 6.2$   | $1.8 \pm 3.4$     | 0.0002±9.8            |              |
| 11907633   | Rattus exulans<br>hide                 | 6.49±9.1        |                  |                  |                  | 9,13±1.6          |                       |              |
| 11912333   | <u>Rattus</u> <u>exulans</u><br>kidney |                 |                  |                  |                  | 17.0±3.0          |                       |              |
| 11913933   | Rattus exulans<br>lungs                |                 |                  |                  |                  | 18,5±5.8          | 0.031±16.0            |              |
| 11924633   | Erolia cuminata<br>viscera             |                 |                  |                  | ,                |                   | Net                   |              |

Table 59 (continued).

(i) (error, ~)

| 1924633 | Erolia                                                                                                         | cummata |
|---------|----------------------------------------------------------------------------------------------------------------|---------|
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|         | viscer                                                                                                         | a       |
|         |                                                                                                                |         |

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Table 59 (continued).

Radionuclide concentration levels, pCi/g ovendry wt (error, %)

| Sample No.        | Туре                                              | 40 <sub>K</sub> | 55Fe            | <sup>60</sup> Co | 90 <sub>Sr</sub> | <sup>137</sup> Cs | 239,240 <sub>Pu</sub> Other |
|-------------------|---------------------------------------------------|-----------------|-----------------|------------------|------------------|-------------------|-----------------------------|
| DAVID<br>11920133 | Sterna fuscata                                    | 8.9±26.7        | 63.5±5.2        |                  |                  |                   |                             |
|                   | VISCELA                                           |                 |                 |                  |                  |                   |                             |
| REX               |                                                   |                 |                 |                  |                  |                   |                             |
| 10157034          | Scaevola frutescens                               | 6.964±8.3       |                 |                  |                  | $0.495\pm8.3$     |                             |
| 10186534          | Messerschmidia argentea                           | 8.896±7.2       |                 |                  |                  | 2.451±2.9         |                             |
| 10186634          | Pisonia grandis                                   | $16.0 \pm 4.1$  |                 | $0.091\pm23.1$   |                  | 2,642±2.2         |                             |
| 11900534          | Anous stolidus<br>eggshell                        |                 | 0.73±16.0       |                  |                  |                   |                             |
| 11920934          | Anous stolidus<br>viscera                         |                 | 50.0±3.7        |                  |                  |                   |                             |
| 11901334          | Anous stolidus<br>egg                             | 7.689±8.9       | 51.4±2.0        |                  |                  |                   | $0.0077 \pm 19.0$           |
| 11902434          | Coenobita perlatus<br>hepatopancreas<br>and gonad | 5.833±10.1      | 1.82±8.0        | 0.566±12.5       | 0.289±4.0        | 0.783±7.2         | 0.00346±11.0                |
| 11903134          | <u>Coenobita</u> perlatus<br>muscle               | 6.676±8.8       | $1.47 \pm 12.0$ | 1.436±6.6        | 0.319±3.0        | 1.05±5.8          | $0.0026 \pm 12.0$           |
| 11903234          | <u>Coenobita perlatus</u><br>exoskeleton          | 1.838±13.0      | 0.085±29.0      |                  | 3.62±2.0         | $0.249 \pm 8.2$   | 0.001±16.0                  |
| 11921034          | Anous stolidus<br>liver                           | 4.887±35.2      | $117.6 \pm 2.0$ |                  |                  |                   |                             |
| 11922734          | Anous stolidus<br>muscle                          | 10.81±8.2       | 43.5±2.0        |                  | 0.00649±19       | .0                | $0.0056 \pm 11.0$           |
| 11927334          | Anous stolidus                                    |                 | $44.77 \pm 3.7$ |                  |                  |                   |                             |

|            |                                       | Radionuclide concentration levels, pCi/g ovendry wt (error, %) |                  |                  |                  |                |                        |                             |  |
|------------|---------------------------------------|----------------------------------------------------------------|------------------|------------------|------------------|----------------|------------------------|-----------------------------|--|
| Sample No. | Туре                                  | <sup>40</sup> K                                                | <sup>55</sup> Fe | <sup>60</sup> Co | <sup>90</sup> Sr | 137Cs          | 239, 240 <sub>Pu</sub> | Other                       |  |
| ELMER      |                                       |                                                                |                  |                  |                  |                |                        |                             |  |
| 10156235   | Messerschmidia argentea               |                                                                |                  |                  | 0.982±2.5        | 2.386±5.0      |                        |                             |  |
| 10156335   | Scaevola frutescens                   | $13.6 \pm 9.2$                                                 |                  |                  | 0.272±4.8        | 2.405±5.1      |                        |                             |  |
| 10156435   | Cocos nucifera                        | $9.734 \pm 12.4$                                               |                  |                  | 0.032±4.0        | 2.14±5.3       |                        | <sup>3</sup> H(0.31±14.4)   |  |
| 10156535   | Messerschmidia argentea               | $9.04 \pm 5.4$                                                 |                  |                  | 0.626±2.8        | 1.657±3.2      |                        |                             |  |
| 10156635   | Scaevola frutescens                   | 11.83±4.0                                                      |                  |                  | $0.617 \pm 2.9$  | 1.475±2.8      |                        |                             |  |
| 10156735   | <u>Cocos</u> nucifera                 | 5.505±8.6                                                      |                  |                  |                  | 3.451±2.5      |                        |                             |  |
| 10156835   | Pandanus tectorius                    | 8.856±6.6                                                      | 0.41±13.0        |                  | $25.14 \pm 3.0$  | 3.091±2.4      | 0.002±22.0             |                             |  |
| 11906335   | <u>Rattus rattus</u><br>viscera       | <b>11.1</b> 9±6.0                                              |                  | 1.39±6.3         | 0.16±1.0         | 19.0±1.0       | 0.0074±14.0            | )                           |  |
| 11907235   | Rattus rattus<br>muscle               | 10.3±6.2                                                       | 0.10±29.0        |                  | 0.06 ±4.0        | 18.4±1.0       | 0.016±31.0             | $\frac{3}{11}$ H (11,3±1,3) |  |
| 11907435   | Rattus rattus<br>liver                | 11.1±12.0                                                      | 0.93±36.0        |                  | 0.018±15.0       | 15.6±2.0       |                        |                             |  |
| 11907735   | Rattus rattus<br>hide                 | 6.5±8.7                                                        |                  |                  |                  | $7.6{\pm}1.7$  |                        |                             |  |
| 11909235   | <u>Rattus rattus</u><br>lung <b>s</b> | 14.7±20.1                                                      |                  |                  | 1.0±4.0          | 16.9±3.8       | 0,14±10.0              |                             |  |
| 11909335   | Rattus rattus<br>kidney               | 21.8±9.5                                                       |                  | $1.74 \pm 8.7$   |                  | 15.0±2.3       |                        |                             |  |
| 11916335   | Rattus rattus<br>bone                 | 9.04±7.2                                                       |                  |                  | 1,42±5.0         | $9.96 \pm 2.4$ | 0.23±6.0               |                             |  |
| WALT       |                                       |                                                                |                  |                  |                  |                |                        |                             |  |
| 10411036   | <u>Guettarda</u> speciosa             | 9.82±4.0                                                       |                  |                  |                  | 0.18±10.3      |                        |                             |  |
| 10411136   | <u>Scaevola</u> frutescens            | 6.986±8.2                                                      | •                |                  |                  | 1.44±2.4       |                        |                             |  |

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Table 59 (continued).

|            |                                       | Radionucli        | de concentr      | ation levels,    | pCi/g oven         | dry wt (erro    | or, %)                 |                             |
|------------|---------------------------------------|-------------------|------------------|------------------|--------------------|-----------------|------------------------|-----------------------------|
| Sample No. | Туре                                  | <sup>40</sup> K   | <sup>55</sup> Fe | <sup>60</sup> Co | 90 <sub>Sr</sub>   | 137Cs           | 239, 240 <sub>Pu</sub> | Other                       |
| ELMER      |                                       |                   |                  |                  |                    |                 |                        |                             |
| 10156235   | Messerschmidia argentea               |                   |                  |                  | 0.982±2.5          | 2.386±5.0       |                        |                             |
| 10156335   | <u>Scaevola</u> <u>frutescens</u>     | $13.6 \pm 9.2$    |                  |                  | 0.272±4.8          | $2.405 \pm 5.1$ |                        |                             |
| 10156435   | <u>Cocos nucifera</u>                 | $9.734 \pm 12.4$  |                  |                  | 0.032±4.0          | $2.14 \pm 5.3$  |                        | <sup>3</sup> H(0.31±14.4)   |
| 10156535   | Messerschmidia argentea               | $9.04 \pm 5.4$    |                  |                  | 0.626±2.8          | 1.657±3.2       |                        |                             |
| 10156635   | <u>Scaevola frutescens</u>            | 11.83±4.0         |                  |                  | 0.617 <b>±</b> 2.9 | 1.475±2.8       |                        |                             |
| 10156735   | Cocos nucifera                        | 5.505±8.6         |                  |                  |                    | 3.451±2.5       |                        |                             |
| 10156835   | Pandanus tectorius                    | 8.856±6.6         | 0.41±13.0        |                  | 25.14±3.0          | 3.091±2.4       | 0.002±22.0             |                             |
| 11906335   | <u>Rattus rattus</u><br>viscera       | <b>11.1</b> 9±6.0 |                  | 1.39±6.3         | $0.16 \pm 1.0$     | 19.0±1.0        | $0.0074 \pm 14.0$      | I                           |
| 11907235   | Rattus rattus<br>muscle               | $10.3\pm6.2$      | 0.10±29.0        |                  | 0.06 ±4.0          | 18.4±1.0        | 0.016 ±31.0            | $\frac{3}{11}$ H (11.3±1.3) |
| 11907435   | Rattus rattus<br>liver                | 11.1±12.0         | 0.93±36.0        |                  | 0.018±15.0         | $15.6 \pm 2.0$  |                        |                             |
| 11907735   | Rattus rattus<br>hide                 | 6.5±8.7           |                  |                  |                    | $7.6{\pm}1.7$   |                        |                             |
| 11909235   | <u>Rattus</u> rattus<br>Iung <b>s</b> | 14.7±20.1         |                  |                  | <b>1</b> .0±4.0    | 16.9±3.8        | $0.14\pm10.0$          |                             |
| 11909335   | Rattus rattus<br>kidney               | 21.8±9.5          |                  | $1.74\pm8.7$     |                    | 15.0±2.3        |                        |                             |
| 11916335   | Rattus rattus<br>bone                 | $9.04 \pm 7.2$    |                  |                  | 1,42±5,0           | $9.96 \pm 2.4$  | 0.23±6.0               |                             |
| WALT       |                                       |                   |                  |                  |                    |                 |                        |                             |
| 10411036   | Guettarda speciosa                    | 9.82±4.0          |                  |                  |                    | 0.18±10.3       |                        |                             |
| 10411136   | Scaevola frutescens                   | 6.986±8.2         |                  |                  |                    | $1.44 \pm 2.4$  |                        |                             |
|            |                                       |                   |                  |                  |                    |                 |                        |                             |

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| Sample No. | Туре                                        | <sup>40</sup> K  | <sup>55</sup> Fe | <sup>60</sup> Co | <sup>90</sup> Sr  | <sup>137</sup> Cs             | 239,240 <sub>Pu</sub> Other      |
|------------|---------------------------------------------|------------------|------------------|------------------|-------------------|-------------------------------|----------------------------------|
| WALT       |                                             |                  |                  |                  |                   |                               |                                  |
| 10411236   | Messerschmidia argentea                     | 6.658±7.6        |                  |                  |                   | 0.38±8.3                      |                                  |
|            |                                             |                  |                  |                  |                   |                               |                                  |
| FRED       |                                             |                  |                  |                  |                   |                               |                                  |
| 10000637   | Messerschmidia argentea                     | 11.23±6.2        |                  |                  | 0.4344.6          | 0.558±7.5                     |                                  |
| 10008637   | Scaevola frutescens                         | $10.36 \pm 6.8$  |                  |                  | $0.234\pm\!\!6.8$ | $0.652 \pm 7.2$               | $0.0006 \pm 11.0$                |
| 10155837   | Messerschmidia argentea                     | 8.829±5.1        |                  |                  | $0.487 \pm 3.2$   | $1.78 \pm 2.5$                |                                  |
| 10188837   | <u>Cocos</u> nucifera                       | 6.387±6.7        |                  |                  | 0.0296.27.0       | $2_1386{\pm}3_16$             | <sup>3</sup> H(0, 39 ± 11, 6)    |
| 10188937   | Scaevola frutescens                         | $7.14 \pm 6.6$   |                  |                  | 0.806±3.3         | 3,80112.3                     |                                  |
| 10189037   | Cocos nucifera                              | 5.59±6.9         |                  |                  | $0.367 \pm 18.0$  | $0.53\pm6.0$                  |                                  |
| 10466937   | Pandanus tectorius                          | $3.382 \pm 13.1$ | 0.85±6.0         |                  | 0.422+2.0         | $4.29{\pm}2.3$                | 0.0077138.0                      |
|            |                                             |                  |                  |                  |                   |                               |                                  |
| GLENN      |                                             |                  |                  |                  |                   |                               |                                  |
| 10021238   | Cocos nucifera                              | 6.13±6.1         |                  |                  | 0.02±4.0          | $0.87 \pm 3.7$                |                                  |
| 10370538   | Messerschmidia argentea                     | $9.752 \pm 6.1$  |                  |                  | $2.51 \pm 1.6$    | $1.27 \pm 4 \hspace{0.1in} 1$ |                                  |
| 10370638   | Cocos nucifera                              | 8.279±4.9        |                  |                  |                   | 1.3+2.9                       |                                  |
| 10370738   | Scaevola frutescens                         | $13.74 \pm 5.2$  |                  |                  | $1.342 \pm 5.0$   | $0.53 \pm 8.0$                |                                  |
| 10370838   | Pisonia grandis                             | 30.28±3.5        |                  |                  | $1.74 \pm 3.0$    | 3.91±2.3                      |                                  |
| 11902638   | <u>Coenobita perlatus</u><br>hepatopancreas | 8.68±11.4        | 1.55±7.0         | $1.124 \pm 11.2$ | 0.432±8.0         | $1.51\pm6.8$                  | $0.006 \pm 32$                   |
|            | and gonad                                   |                  |                  |                  |                   |                               |                                  |
| 10008038   | Morinda citrifolia                          | $15.7 \pm 3.1$   |                  |                  | 0.405±5.3         | 0.450±5 0                     | 149                              |
| 10008138   | <u>Pisonia grandis</u>                      | 25.79±4.3        | 0.81±19.0        |                  | 2,88±2.2          | <b>1.</b> 86±3.8              | 102 <sub>Rh</sub><br>(0.17±21.2) |
| 10008238   | <u>Cocos</u> nucif <b>era</b>               | $7.527 \pm 9.1$  |                  |                  | 0.326±6.8         | $1.655\pm\!4.1$               |                                  |
| 10008338   | <u>Morinda</u> citrifolia                   | 22.29±4.3        |                  |                  | 1.58±3.0          | 0.638±72                      |                                  |

|            |                                             | Radionuclio      | de concentra     | ation levels,    | pCi/g oven       | dry wt (erro        | r, %)                  |                               |
|------------|---------------------------------------------|------------------|------------------|------------------|------------------|---------------------|------------------------|-------------------------------|
| Sample No. | Туре                                        | 40 <sub>K</sub>  | <sup>55</sup> Fe | <sup>60</sup> Co | <sup>90</sup> Sr | <sup>137</sup> Cs   | 239, 240 <sub>Pu</sub> | Other                         |
| GLENN      |                                             |                  |                  |                  |                  |                     |                        |                               |
| 10008438   | Messerschmidia argentea                     | 21.81±4.7        |                  |                  | 2.05±1.8         | <b>1.245±4</b> 9    |                        |                               |
| 10008538   | Scaevola frutescens                         | $12.84 \pm 5.7$  |                  |                  | 1.54±2.2         | $0.637 \pm 7.0$     |                        |                               |
| 11903338   | Coenobita perlatus<br>muscle                | 7,856±11.3       | 1.32±18.0        | $1.97 \pm 7.5$   | 0.91±5,0         | 1.51±6,6            | 0.11±7.0               |                               |
| 11903438   | Coenobita perlatus<br>exoskeleton           | $1.519 \pm 19.2$ |                  |                  | $9.14\pm2.0$     | 0.25 <b>2±1</b> 0.3 | 0.0011±14.0            | I                             |
| 11905338   | Birgus latro<br>muscle                      | 10.45±7.1        | 0.68±13.0        |                  |                  | 1.8813.7            |                        | <sup>3</sup> H<br>(0.69±4.8)  |
| 11905438   | Birgus latro<br>exoskeleton                 | 1.06±29.0        |                  |                  | 10.4±1.0         | 0.313±9.3           | 0.0035±10.0            |                               |
| 11905538   | Birgus latro<br>hepatopancreas<br>and gonad | 2.338±15.0       |                  | 0.276±15.7       | 0.269±3.0        | 0.545±6.1           |                        | <sup>3</sup> H<br>(0.27±10.7) |
| 11906538   | Rattus exulans<br>viscera                   | $11.75 \pm 6.4$  |                  | $2.06 \pm 5.3$   | 0.28±6.0         | 1,88±4.0            | $0.036 \pm 13.0$       |                               |
| 11910738   | Rattus exulans<br>liver                     | 12.79±10.2       | 19.28±4.0        | 1.81±6.9         |                  | 1.455±8.5           | $0.035\pm6.0$          |                               |
| 11915638   | Rattus exulans<br>bone                      | 10.61±9.0        |                  | 0.711±15.8       | 2.67±2.0         | 6.02±2.2            | 0.87±4.0               |                               |
| 11915738   | <u>Rattus exulans</u><br>muscle             | 8.18±8.3         | 4.49±4.0         | 0.48±15.4        | 1.03±3.0         | 1.76±3.7            | 0.017±7.0              |                               |
| 10021538   | Pisonia grandis<br>wood                     | 7.26±7.8         |                  |                  |                  | 0.37±10.2           |                        |                               |
| 11905638   | Birgus latro<br>skin, gills, green gland    | 7.35±18.6        |                  | 0.83±22.8        |                  | 1.74±7.8            |                        |                               |
| 11906438   | Rattus exulans<br>hide                      | 2.3±11.9         |                  |                  |                  | 0.33±8.0            |                        |                               |
| 11912438   | Rattus exulans<br>kidney                    |                  |                  | 2.4±14.0         |                  | 1.46±19.1           |                        |                               |

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|            | hide                                           |                     |                  |                  |                  | 0,0010.0        |                                 |
|------------|------------------------------------------------|---------------------|------------------|------------------|------------------|-----------------|---------------------------------|
| 11912438   | Rattus exulans<br>kidney                       |                     |                  | 2.4±14.0         |                  | $1.46 \pm 19.1$ |                                 |
|            | -                                              |                     |                  |                  |                  |                 |                                 |
|            | Table 59 (continued)                           |                     |                  |                  |                  |                 |                                 |
|            |                                                | Radionucli          | de concentra     | ation levels,    | pCi/g ovend      | ry wt (error    | $(\alpha, \alpha')$             |
| Sample No. | Туре                                           | 40 <sub>K</sub>     | <sup>55</sup> Fe | <sup>60</sup> Co | <sup>90</sup> Sr | 137Cs           | 239,240 Pu Other                |
| GLENN      |                                                |                     |                  |                  |                  |                 |                                 |
| 11912538   | Rattus exulans<br>Iungs                        | 20.7±11.9           |                  |                  |                  | 1.74±11.0       | 0.30±7.0                        |
| HENRY      |                                                |                     |                  |                  |                  |                 |                                 |
| 10020739   | Messerschmidia argentea                        | 12.77±5.8           |                  |                  | 1.98±2.9         | 0.52±8.0        |                                 |
| 10021039   | Lepturus repens                                | 11.29±7.1           |                  |                  | 0.059±13.0       | 0.099±37.4      | 0.0021±20.0                     |
| 10021439   | Scaevola frutescens                            | $12.64 \pm 5.8$     |                  |                  |                  | 0.195±17.1      |                                 |
| 10021639   | Morinda citrifolia                             | 17.3±3.3            |                  |                  | $0.325 \pm 5.1$  | 1,28±3.2        |                                 |
| 10022739   | Cocos nucifera                                 | 3.39.±5.5           |                  |                  |                  | 0.59±2.5        |                                 |
| 11902239   | Coenobita perlatus<br>hepatopancreas and gonad | 5.725±9.9           |                  | 0.98±8.4         | $0.496 \pm 3.0$  | 1.17±5-3        |                                 |
| 11903539   | <u>Coenobita perlatus</u><br>muscle            | 7.694±7.8           | 0.98±12.0        | $1.996 \pm 5.2$  | 0.64±1.0         | 1.08±5.5        | 0 0066 ±7.0                     |
| 11903639   | <u>Coenobita perlatus</u><br>exoskeleton       | 2.344± <b>1</b> 3.5 | 0.08±17.0        |                  | $9.64{\pm}1.0$   | $0.24 \pm 10.5$ | $0.0009\pm20.0$                 |
| 11912139   | Anous stolidus<br>egg                          | 3.385±9.9           | 54.1±2.0         |                  |                  |                 | <sup>65</sup> Zn<br>(0,79±23.1) |
| 11912039   | Anous stolidus<br>eggshell                     |                     | 8.6±1.9          |                  |                  |                 |                                 |
| IRWIN      |                                                |                     |                  |                  |                  |                 |                                 |
| 10245040   | Messerschmidia argentea                        | 13.54±5.9           |                  |                  | $1.73 \pm 2.6$   | 0.533±8.6       |                                 |
| 10245140   | Pisonia grandis                                | 21.77±4.1           |                  |                  | $0.595 \pm 5.4$  | 1.88±3.3        | $0.0015 \pm 15.0$               |
| 10245240   | Cocos nucifera                                 | 6.995 <b>±7.0</b>   |                  |                  |                  | 0.329±9.5       |                                 |
| 10245340   | <u>Terminalia</u> samoensis                    | 11.36±5.8           |                  |                  | 0.923±4.6        | 0.772±5.7       | 0.0013±7.9                      |
| 11901240   | Anous stolidus<br>egg                          | 7.49±10.2           | 5.14±6.0         |                  |                  |                 | $0.0009 \pm 21.0$               |

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|                                        |                                                                                                                  | Radionuclide concentration levels, pCi/g ovendry wt (error, %) |                  |                  |                  |                |                             |  |
|----------------------------------------|------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------|------------------|------------------|------------------|----------------|-----------------------------|--|
| Sample No.                             | Туре                                                                                                             | 40 <sub>K</sub>                                                | <sup>55</sup> Fe | <sup>60</sup> Co | <sup>90</sup> Sr | 137Cs          | 239,240 <sub>Pu</sub> Other |  |
| IRWIN                                  |                                                                                                                  |                                                                |                  |                  |                  |                |                             |  |
| 11902340                               | Coenobita perlatus<br>hepatopancreas and gonad                                                                   | 7.752±9.3                                                      | 1.78±5.0         | 0.893±10.0       | 0.446±4.0        | 0.579±10.0     | $0.0053 \pm 13.0$           |  |
| 11903740                               | Coenobita perlatus<br>muscle                                                                                     | 6.743±9.3                                                      | 0.75±17.0        | $1.77 \pm 6.2$   | 0.309±4.0        | 0.553±10.0     | 0.01248±13.0                |  |
| 11903840                               | <u>Coenobita perlatus</u><br>exoskeleton                                                                         | 2.73±13.9                                                      | 0.11±11.0        |                  | 4.78±1.0         | 0.098±24.6     | 0.00078±19.0                |  |
| 11918640                               | Anous stolidus<br>liver                                                                                          | $15.84 \pm 14.5$                                               | 423±2.0          | 0.63±22.4        | 0.23±15.0        |                | 0.0242±26.0                 |  |
| 11922540                               | Anous stolidus                                                                                                   | 9.279±15.9                                                     | 169±2.0          | 0.61±27.9        |                  |                | $0.0434\pm8.0$              |  |
| 11927040                               | Anous stolidus<br>bone                                                                                           |                                                                | 49.1±5.3         |                  |                  |                |                             |  |
| 11900340                               | Anous stolidus<br>eggshell                                                                                       |                                                                |                  |                  |                  |                |                             |  |
| 11920640                               | <u>Anous stolidus</u><br>viscera                                                                                 |                                                                | 46.0±9.9         |                  |                  |                |                             |  |
| JAMES                                  |                                                                                                                  |                                                                |                  |                  |                  |                |                             |  |
| 10242541                               | Messerschmidia argentea                                                                                          | 17.7±3.5                                                       |                  | 0.25±23.3        |                  | $1.76 \pm 2.7$ |                             |  |
| 10242641                               | Pisonia grandis                                                                                                  | 12.66±5.8                                                      |                  |                  |                  | 1.55±3.9       |                             |  |
| 10242741                               | Guettarda speciosa                                                                                               | $13.74 \pm 5.7$                                                |                  |                  |                  | 0.683±6.9      |                             |  |
| 10242841                               | Morinda citrifolia                                                                                               | 16,99±5.2                                                      |                  |                  | 1.85±3,5         | 2.23±3.4       |                             |  |
| 10242941                               | <u>Scaevola frutescens</u>                                                                                       | 9.419±7.6                                                      |                  |                  |                  | 0.517±8.8      |                             |  |
| 11905741                               | Birgus latro<br>muscle                                                                                           | 9.617±6.2                                                      | 1.84±6.0         | 1,05±8.7         | 0.079±5.0        | 1,25±4,1       |                             |  |
| 11905841                               | Birgus latro<br>exoskeleton                                                                                      | 1.445±18.2                                                     | 0.30±8.0         | 0.11±4.5         | 5.9±2.0          | 0.223±10.4     | 0.00195±12.0                |  |
| 11905941                               | Birgus latro<br>hepatopancreas and gonad                                                                         | 4.005±12.8                                                     | 12.8±2.0         | 1.56±6.6         |                  | 0.317±14.2     |                             |  |
| والمالية المتناه والمكففة فالشريط والم | and the second | ad mar                                                         |                  |                  |                  |                |                             |  |

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|                                                                               | muscle                                   |                 |                  |                  |                  |                   |                                                                                                                  |  |  |
|-------------------------------------------------------------------------------|------------------------------------------|-----------------|------------------|------------------|------------------|-------------------|------------------------------------------------------------------------------------------------------------------|--|--|
| 11905841                                                                      | Birgus latro<br>exoskeleton              | 1.445±18.2      | 0.30±8.0         | 0.11±4.5         | 5.9±2.0          | 0.223±10.4        | 0.00195±12.0                                                                                                     |  |  |
| 11905941                                                                      | Birgus latro<br>hepatopancreas and gonad | 4.005±12.8      | 12.8±2.0         | 1.56±6.6         |                  | 0.317±14.2        |                                                                                                                  |  |  |
| A State Sec.                                                                  | Č.                                       |                 |                  |                  |                  |                   | and the second |  |  |
|                                                                               |                                          |                 |                  |                  |                  |                   |                                                                                                                  |  |  |
|                                                                               | Table 59 (continued                      | ).              |                  |                  |                  |                   |                                                                                                                  |  |  |
| Radionuclide concentration levels, $pCi/g$ ovendry wt (error, $\frac{2}{2}$ ) |                                          |                 |                  |                  |                  |                   |                                                                                                                  |  |  |
| Sample No.                                                                    | Туре                                     | 40 <sub>K</sub> | <sup>55</sup> Fe | <sup>60</sup> Co | 90 <sub>Sr</sub> | <sup>137</sup> Cs | 239,240 Pu Other                                                                                                 |  |  |
| JAMES                                                                         |                                          |                 |                  |                  |                  |                   |                                                                                                                  |  |  |
| 11906041                                                                      | Birgus latro<br>skin, gills, green gland | 7.13±20.1       |                  | 2.3±9.6          |                  | $1.15 \pm 11.2$   |                                                                                                                  |  |  |
| 11906141                                                                      | Birgus latro<br>miscellany               | 5.35±16.2       |                  | 0,98±15.5        |                  | 0.79+10.4         |                                                                                                                  |  |  |
| KEITH                                                                         |                                          |                 |                  |                  |                  |                   |                                                                                                                  |  |  |
| 10226942                                                                      | Pandanus tectorius                       | $12.7 \pm 5.9$  | 12.2±3.0         |                  | 13.11±4.0        | $0.86 \pm 6.1$    | $^{3}$ H(2.044.0)                                                                                                |  |  |
| 10243042                                                                      | Messerschmidia argentea                  | 12.45±5.8       |                  | $0.20 \pm 24.6$  | $0.318 \pm 9.2$  | $0.255 \pm 14.0$  | $0.00445\pm27.0$                                                                                                 |  |  |
| 10243142                                                                      | Pisonia grandis                          | 30.81±3.6       |                  |                  | $3.0 \pm 2.6$    | $3.65 \pm 2.4$    |                                                                                                                  |  |  |
| 10243242                                                                      | Cocos nucifera                           | 7.689±6.6       |                  |                  |                  | 0.95±4.5          |                                                                                                                  |  |  |
| 10243342                                                                      | <u>Guettarda speciosa</u>                | $12.87 \pm 5.7$ |                  |                  | $1.74 \pm 4.6$   | $0.471 \pm 8.7$   | <i>.</i>                                                                                                         |  |  |
| 10243442                                                                      | Pandanus tectorius                       | $8.18 \pm 5.2$  | $0.36 \pm 29.0$  |                  |                  | $0.569 \pm 5.4$   |                                                                                                                  |  |  |
| 10243542                                                                      | Scaevola frutescens                      | 15.52±8.2       |                  |                  | $0.64 \pm 4.6$   | $0.427 \pm 17.4$  |                                                                                                                  |  |  |
| 11904442                                                                      | Birgus latro<br>muscle                   | 10.11±6.0       | $1.46 \pm 6.0$   | 0.42±13.2        | 1.19±4.0         | 1,92±3.2          |                                                                                                                  |  |  |
| 11904542                                                                      | <u>Birgus latro</u><br>exoskeleton       | 3.349±12.4      | 0.18±10.0        |                  | $9.96 \pm 1.0$   | 0.512±8.1         | $0.00067\pm 26.0$                                                                                                |  |  |
| 11904642                                                                      | Birgus latro<br>hepatopancreas and gonad | 3.205±13.3      | $6.17 \pm 3.0$   | 1.03±8.1         | 0.401±6.0        | 0.496±8.6         | 0.0098±6.0                                                                                                       |  |  |
| 11920742                                                                      | <u>Anous stolidus</u><br>viscera         | 8.968±16.3      | 80.2±3.0         |                  |                  |                   |                                                                                                                  |  |  |
| 11922642                                                                      | Anous stolidus<br>muscle                 | 12.96±7.9       |                  | 0.452±20.9       |                  |                   | 0.001±18.0                                                                                                       |  |  |
| 11927142                                                                      | Anous stolidus<br>bone                   | 3.797±31.6      | 68.5±3.4         | 0.312±23.5       |                  |                   |                                                                                                                  |  |  |
| 11918742                                                                      | Anous stolidus<br>liver                  |                 |                  | 0.69±17.5        |                  |                   |                                                                                                                  |  |  |

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| Radionuclide concentration le | evels, pC | li/g | ovendry | v wt ( | error. | <u>%</u> ) |
|-------------------------------|-----------|------|---------|--------|--------|------------|
| -                             |           |      |         |        |        | (1)1       |

| Sample No. | Туре                                             | 40 <sub>K</sub> | <sup>55</sup> Fe | <sup>60</sup> Co | <sup>90</sup> Sr | 137Cs          | 239,240 <sub>Pu</sub> | Other                            |
|------------|--------------------------------------------------|-----------------|------------------|------------------|------------------|----------------|-----------------------|----------------------------------|
| KEITH      |                                                  |                 |                  |                  |                  |                |                       |                                  |
| 11904742   | <u>Birgus latro</u><br>skin, gills, green gland  | 7.37±13.2       |                  | $2.54 \pm 7.0$   |                  | 3.87±3.2       |                       |                                  |
| 11904842   | Birgus latro<br>shell, gills, dust,<br>gut blood | 11.4±18.4       |                  |                  |                  | 1.60±11.6      |                       |                                  |
| LEROY      |                                                  |                 |                  |                  |                  |                |                       |                                  |
| 10020443   | Pandanus tectorius                               | 7.995±7.9       | 0.21±16.0        |                  | 1.69±3.0         | $9.14 \pm 1.5$ | 0.0022±11.0           | )                                |
| 10020343   | Pandanus tectorius<br>fruit                      | 30.2±4.9        |                  |                  | <b>16.26±1.0</b> | 26.2±1.1       |                       |                                  |
| 10020143   | Scaevola frutescens                              | $13.29 \pm 5.6$ |                  |                  | $3.74 \pm 1.3$   | 1,80±3,6       |                       |                                  |
| 10020243   | Pisonia grandis                                  | 34.27±3.4       |                  |                  | 14.86±1.0        | 10.17±14.0     |                       |                                  |
| 10020943   | Messerschmidia argentea                          | $15.09 \pm 5.3$ |                  | 0.21±25.5        | $14.37 \pm 1.0$  | $4.71 \pm 2.1$ |                       |                                  |
| 10022543   | Cocos nucifera                                   | 4.07±5.1        |                  |                  | 0.189±5.0        | 3.83±1.9       |                       | 102 <sub>Rh</sub><br>(0,13±24,9) |
| 11904943   | Birgus latro<br>muscle                           | 8.797±5.9       | $1,59\pm 5.0$    | $1.234\pm 6.5$   | $1.577 \pm 2.0$  | $12.6 \pm 1.0$ | 0.0031±19.0           | <sup>3</sup> H<br>(0.88±3.4)     |
| 11905043   | Birgus latro<br>exoskeleton                      | 1.579±19.9      | 0.17±10.0        | 0.171±21.3       | 89.6±1.0         | 2.52±2.2       | 0.025±17.0            |                                  |
| 11905143   | Birgus latro<br>hepatapancreas and gonad         | 2.47±11.8       | 5.05±3.0         | 0.45±8.2         | 2.58±2.0         | 3.67±1.4       | 0,0038±21,0           | <sup>3</sup> H<br>(0.21±14.8)    |
| 11917143   | Anous tenuirostris<br>muscle                     | 10.95±10.4      | 64.4±2.0         | 2.065±8.4        |                  |                | 0.0033±22.0           |                                  |
| 11918843   | <u>Anous tenuirostris</u><br>liver               |                 | 810.8±2.0        | 2.83±13.7        | 0.402±9.0        |                | 0.0072±31.0           |                                  |
| 11920843   | Anous tenuirostris<br>viscera                    | 7.824±19.0      | 71.6±1.3         | 1.01±15.6        |                  |                |                       |                                  |
| 11920843   | Anous tenuirostris<br>viscera             | 7.824±19.       | 0 71.6±1.3       | 1.01±15.6        |                  |                 |                  |  |
|------------|-------------------------------------------|-----------------|------------------|------------------|------------------|-----------------|------------------|--|
|            |                                           |                 |                  |                  |                  |                 |                  |  |
|            | Table 59 (continued).                     | Radionucli      | de concentra     | ation levels,    | pCi/g o          | vendry wt (erro | <u>r, %)</u>     |  |
| Sample No. | Туре                                      | 40 <sub>K</sub> | 55 <sub>Fe</sub> | <sup>60</sup> Co | 90 <sub>Sr</sub> | 137 C s         | 239,240 Pu Other |  |
| LEROY      |                                           |                 |                  |                  |                  |                 |                  |  |
| 11927243   | Anous tenuirostris<br>bone                |                 | 109.5±4.4        | $0.94 \pm 22.3$  |                  |                 |                  |  |
| 11905243   | <u>Birgus latro</u><br>miscell <b>any</b> | 5.16±12.1       |                  | 1.78±5.6         |                  | $11.14 \pm 1.2$ |                  |  |

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|              |                 | Activ            | itv, pCi/g,      | dry wt            |                       |
|--------------|-----------------|------------------|------------------|-------------------|-----------------------|
| Island       | 40 <sub>K</sub> | <sup>60</sup> Co | <sup>90</sup> Sr | 137 <sub>Cs</sub> | 239,240 <sub>Pu</sub> |
| ALICE        | 13.38           |                  | 138.3            | 222.8             | 0.025                 |
| BELLE        | 15.86           |                  | 25.2             | 5,83              | 0.036                 |
| CLARA        | 13.33           |                  | 127.5            | 149.10            |                       |
| DAISY        | 11.10           | 1.45             | 12.21            | 5,90              | 0.055                 |
| EDNA         | 11.1            | 0.24             |                  | 6.73              |                       |
| IRENE        | 13.04           | 23,86            | 536.0            | 62.60             |                       |
| IRENE        | 18.16           |                  |                  | 2.20              | 0.004                 |
| IRENE        | 14.61           | 2.77             | 21.76            | 4.10              | 0.0157                |
| IRENE        | 12.74           | 3.39             | 159.0            | 407.30            | 0.002                 |
| IRENE (wood) | 1.94            | 1.59             | 16,98            | 13.02             | 0.006                 |
| JANET        | 12.72           |                  | 18.4             | 36.42             | 0.015                 |
| JANET        | 10.50           |                  | 46.4             | 385.80            | 0.003                 |
| JANET        | 9.95            |                  | 43.51            | 124.80            | 0.005                 |
| JANET        | 14.25           |                  | 48.20            | 299.40            | 0.004                 |
| JANET        | 12.17           | ~~~~             | 83.78            | 298.70            | 0.005                 |
| JANET        | 15.30           |                  | 121.2            | 158.30            | 0.003                 |
| JANET        | 10.43           | 0.22             | 106.0            | 526.10            |                       |
| JANET        | 18.32           | 0.25             | 40.36            | 545.90            | 0.010                 |
| JANET        | 13.29           |                  | 45.75            | 322.70            |                       |
| KATE         | 9.62            |                  | 3.75             | 4.26              | 0.005                 |
| LUCY         | 10.73           |                  |                  | 6.36              |                       |
| MARY         | 13.24           |                  | 7.57             | 7.12              |                       |
| MARY/NANCY   | 12.62           | 0.67             |                  | 55.05             |                       |
| NANCY        | 7.81            |                  | 27,30            | 40.24             | 0.023                 |
| OLIVE        | 10.73           |                  |                  | 9.54              |                       |
| PEARL        | 14.66           |                  | 0.47             | 0.29              |                       |
| RUBY         | 9.19            | 0.99             |                  | 19.19             |                       |
| RUBY         | 6.23            | 0.90             |                  | 39.01             |                       |
| SALLY        | 8.28            | 0.10             | 4.86             | 12.63             | 0.059                 |
| TILDA        | 10.13           |                  | 10.27            | 58.78             |                       |
| URSULA       | 10.09           |                  | 13.60            | 104.9 <b>0</b>    |                       |
| VERA         | 7.07            |                  | 12.79            | 10.77             | 0.002                 |
| WILMA        | 5.00            |                  |                  | 6.19              |                       |

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Table 50. Radionuclide concentrations in <u>Messerschmidia argentea</u> collected at Enewetak Atoll, 1972-1973.

| Activity, pCi/g, dry wt |                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                    |  |  |  |
|-------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|
| 40 <sub>K</sub>         | <sup>60</sup> Co                                                                                                                                                                                                                                                                                         | 90 <sub>Sr</sub>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <sup>137</sup> Cs                                                                                                                                                                                                                                                                                                                  | 239,240 <sub>Pu</sub>                                                                                                                                                                                                                                                                                                                                                                                              |  |  |  |
| 14.19                   |                                                                                                                                                                                                                                                                                                          | 0.64                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 2.28                                                                                                                                                                                                                                                                                                                               | 0.004                                                                                                                                                                                                                                                                                                                                                                                                              |  |  |  |
| 14.26                   |                                                                                                                                                                                                                                                                                                          | 1.43                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 3.81                                                                                                                                                                                                                                                                                                                               | 0.011                                                                                                                                                                                                                                                                                                                                                                                                              |  |  |  |
| 10.91                   |                                                                                                                                                                                                                                                                                                          | 8.6 <b>0</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 95.3 <b>0</b>                                                                                                                                                                                                                                                                                                                      | 0.129                                                                                                                                                                                                                                                                                                                                                                                                              |  |  |  |
| 10.33                   |                                                                                                                                                                                                                                                                                                          | 1.94                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 17.30                                                                                                                                                                                                                                                                                                                              | 0.766                                                                                                                                                                                                                                                                                                                                                                                                              |  |  |  |
| 9.33                    | 1.16                                                                                                                                                                                                                                                                                                     | 257.20                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 5644.00                                                                                                                                                                                                                                                                                                                            | 0.114                                                                                                                                                                                                                                                                                                                                                                                                              |  |  |  |
| 9.16                    |                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 0.26                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                    |  |  |  |
| 6.81                    |                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 0.34                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                    |  |  |  |
| 11.90                   |                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 0.73                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                    |  |  |  |
| 11.57                   |                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 0.85                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                    |  |  |  |
| 8.03                    |                                                                                                                                                                                                                                                                                                          | 0.33                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 1.16                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                    |  |  |  |
| 10.90                   |                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 0.43                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                    |  |  |  |
| 13.55                   |                                                                                                                                                                                                                                                                                                          | 0.46                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 1.09                                                                                                                                                                                                                                                                                                                               | 0.0061                                                                                                                                                                                                                                                                                                                                                                                                             |  |  |  |
| 11.02                   |                                                                                                                                                                                                                                                                                                          | 0.76                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 7.24                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                    |  |  |  |
| 13.22                   |                                                                                                                                                                                                                                                                                                          | 1.06                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 2.58                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                    |  |  |  |
| 3.88                    |                                                                                                                                                                                                                                                                                                          | 0.75                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 15.84                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                    |  |  |  |
| 8.89                    |                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 2.45                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                    |  |  |  |
|                         |                                                                                                                                                                                                                                                                                                          | 0.98                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 2.39                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                    |  |  |  |
| 9.04                    |                                                                                                                                                                                                                                                                                                          | 0.63                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 1.66                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                    |  |  |  |
| 6.66                    |                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 0.38                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                    |  |  |  |
| 11.23                   |                                                                                                                                                                                                                                                                                                          | 0.43                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 0.56                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                    |  |  |  |
| 8.83                    |                                                                                                                                                                                                                                                                                                          | 0.49                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 1.78                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                    |  |  |  |
| 21.81                   |                                                                                                                                                                                                                                                                                                          | 2.05                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 1.24                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                    |  |  |  |
| 9.75                    |                                                                                                                                                                                                                                                                                                          | 2.51                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 1.27                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                    |  |  |  |
| 12.77                   |                                                                                                                                                                                                                                                                                                          | 1.98                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 0.52                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                    |  |  |  |
| 13.54                   | 0.25                                                                                                                                                                                                                                                                                                     | 1.73                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 0.53                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                    |  |  |  |
| 17.95                   |                                                                                                                                                                                                                                                                                                          | ** ** **                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 1.76                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                    |  |  |  |
| 12.45                   | 0.20                                                                                                                                                                                                                                                                                                     | 0.32                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 0.25                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                    |  |  |  |
| 15.09                   |                                                                                                                                                                                                                                                                                                          | 14.37                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 4.71                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                    |  |  |  |
|                         | $\begin{array}{r} 40_{\rm K} \\ 14.19 \\ 14.26 \\ 10.91 \\ 10.33 \\ 9.33 \\ 9.33 \\ 9.33 \\ 9.16 \\ 6.81 \\ 11.90 \\ 11.57 \\ 8.03 \\ 10.90 \\ 13.55 \\ 11.02 \\ 13.22 \\ 3.88 \\ 8.89 \\ \\ 9.04 \\ 6.66 \\ 11.23 \\ 8.83 \\ 21.81 \\ 9.75 \\ 12.77 \\ 13.54 \\ 17.95 \\ 12.45 \\ 15.09 \\ \end{array}$ | Activ $40_K$ $60_{Co}$ 14. 19            10. 91            10. 91            10. 33            9. 33         1. 16           9. 16            6. 81            11. 90            11. 90            11. 57            8. 03            10. 90            11. 57            13. 55            13. 55            13. 22            3. 88            9. 04            9. 04            9. 04            9. 04            9. 04            9. 75            11. 23            9. 75            12. 77            13. 54         0. 25           17. 95            12. 45         0. 20           15. 09 <td>Activity, <math>pCi/g</math> <math>40_K</math> <math>60_{Co}</math> <math>90_{Sr}</math>           14. 19          <math>0.64</math>           14. 26          <math>1.43</math>           10. 91          <math>8.60</math>           10. 33          <math>1.94</math>           9. 33         <math>1.16</math> <math>257.20</math>           9. 16             <math>6.81</math> <math>11.90</math> <math>11.57</math> <math>8.03</math>          0.33           <math>10.90</math> <math>13.55</math> <math>0.76</math> <math>13.22</math> <math>0.76</math> <math>13.22</math> <math>0.98</math> <math>9.04</math> <math>0.63</math> <math>6.66</math> <math>11. 23</math> <math>0.43</math> <math>8.83</math>          0.43           <math>8.83</math> <math>0.43</math> <math>12.77</math> <math>0.43</math> <math>13.54</math> <math>0.25</math> <math>1.73</math> <math>17.</math></td> <td>Activity, pCi/g, dry wt<math>40_{\rm K}</math><math>60_{\rm Co}</math><math>90_{\rm Sr}</math><math>137_{\rm Cs}</math>14. 190. 642. 2814. 261. 433. 8110. 918. 6095. 3010. 331. 9417. 309. 331. 16257. 205644. 009. 160. 266. 810. 3411. 900. 7311. 570. 3311. 570. 4313. 550. 4610. 900. 767. 2413. 221. 062. 583. 880. 7515. 848. 899. 040. 631. 666. 660. 430. 568. 839. 040. 430. 568. 831. 980. 5213. 540. 2513. 540. 200. 320. 2515. 0914. 374. 71</td> | Activity, $pCi/g$ $40_K$ $60_{Co}$ $90_{Sr}$ 14. 19 $0.64$ 14. 26 $1.43$ 10. 91 $8.60$ 10. 33 $1.94$ 9. 33 $1.16$ $257.20$ 9. 16 $6.81$ $11.90$ $11.57$ $8.03$ 0.33 $10.90$ $13.55$ $0.76$ $13.22$ $0.76$ $13.22$ $0.98$ $9.04$ $0.63$ $6.66$ $11. 23$ $0.43$ $8.83$ 0.43 $8.83$ $0.43$ $12.77$ $0.43$ $13.54$ $0.25$ $1.73$ $17.$ | Activity, pCi/g, dry wt $40_{\rm K}$ $60_{\rm Co}$ $90_{\rm Sr}$ $137_{\rm Cs}$ 14. 190. 642. 2814. 261. 433. 8110. 918. 6095. 3010. 331. 9417. 309. 331. 16257. 205644. 009. 160. 266. 810. 3411. 900. 7311. 570. 3311. 570. 4313. 550. 4610. 900. 767. 2413. 221. 062. 583. 880. 7515. 848. 899. 040. 631. 666. 660. 430. 568. 839. 040. 430. 568. 831. 980. 5213. 540. 2513. 540. 200. 320. 2515. 0914. 374. 71 |  |  |  |

## Table 60 (continued).

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| Activity, pCi/g, dry wt |                 |                  |                  |                   |                       |                  |
|-------------------------|-----------------|------------------|------------------|-------------------|-----------------------|------------------|
| Island                  | 40 <sub>K</sub> | <sup>60</sup> Со | <sup>90</sup> Sr | <sup>137</sup> Cs | 239,240 <sub>Pu</sub> | <sup>55</sup> Fe |
| ALICE                   | 12.82           |                  | 32.7             | 66.53             |                       |                  |
| BELLE                   | 12.45           |                  | 2.27             | 1.42              | 0.072                 |                  |
| CLARA                   | 12.37           |                  | 51.80            | 51.04             | 0.048                 | 3.37             |
| DAISY                   | 20,26           | 0.48             | 50.9             | 38.80             | 0.046                 |                  |
| IRENE                   | 17.09           | 47.40            | 110.40           | 43.14             | 0.0044                | 33.7             |
| IRENE                   | 14.08           |                  | 1.14             | 1.67              | 0.031                 |                  |
| IRENE                   | 12,68           | 17.07            | 8.56             | 4.28              | 0.028                 | 26.4             |
| IRENE                   | 10.41           | 21.14            | 57.21            | 205.20            | 0.003                 |                  |
| IRENE (wood)            | 1.82            | 0.91             | 4.60             | 2.22              | 0.003                 |                  |
| JANET                   | 17.44           |                  | 12.16            | 30.50             | 0.016                 |                  |
| JANET                   | 18.12           |                  | 36.93            | 258.60            |                       |                  |
| JANET                   | 14.31           |                  | 17.34            | 63.29             |                       |                  |
| JANET                   | 13.65           | 0.45             | 35.72            | 223.40            | 0.003                 |                  |
| JANET                   | 16.73           |                  | 31.53            | 294.60            | 0.010                 |                  |
| JANET                   | 12.96           | 0.21             | 32.66            | 54.95             | 0.007                 |                  |
| JANET                   | 20.57           | 0.24             | 83.33            | 405.90            | 0.004                 |                  |
| JANET                   | 18.28           |                  | 16.61            | 134.10            | 0.005                 |                  |
| KATE                    | 14.60           |                  |                  | 16.36             |                       |                  |
| LUCY                    | 13.01           |                  |                  | 12.73             |                       |                  |
| MARY                    | 16.14           |                  | 16.76            | 12.77             |                       |                  |
| NANCY                   | 10,74           |                  | 11.89            | 4.12              | 0.012                 | 0.05             |
| OLIVE                   | 13.30           |                  |                  | 4.35              |                       |                  |
| PEARL                   | 16.50           |                  | 0.35             | 0.34              |                       |                  |
| PEARL                   | 12.52           | 0.16             | 20.99            | 30.82             |                       |                  |
| SALLY                   | 10.78           |                  | 6.67             | 13.38             | 0.096                 |                  |
| TILDA                   | 11.39           |                  | 9.05             | 24.94             | 0.0042                |                  |
| URSULA                  | 5.45            |                  | 6.13             | 91.49             |                       |                  |
| URSULA                  | 13.47           |                  |                  | 0.29              |                       |                  |
| VERA                    | 8.18            |                  | 4.49             | 1.69              |                       |                  |
| WILMA                   | 10.31           |                  |                  | 1.24              |                       |                  |

 Table 61.
 Radionuclide concentrations in Scaevola frutescens collected at Enewetak Atoll, 1972-1973.

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|        | Activity, pCi/g, dry wt |                  |                  |                   |                       |                  |  |  |
|--------|-------------------------|------------------|------------------|-------------------|-----------------------|------------------|--|--|
| Island | 40 <sub>K</sub>         | <sup>60</sup> Co | <sup>90</sup> Sr | <sup>137</sup> Cs | 239,240 <sub>Pu</sub> | <sup>55</sup> Fe |  |  |
| YVONNE | 13.20                   | 0.511            | 1.76             | 11.88             | 0.026                 |                  |  |  |
| YVONNE | 14.16                   |                  | 0.44             | 1.57              | 0.004                 |                  |  |  |
| YVONNE | 15.00                   | 0.25             | 0.66             | 8.06              | 1.293                 |                  |  |  |
| YVONNE | 10.68                   | 20.26            | 159.00           | 609.90            | 0.323                 |                  |  |  |
| YVONNE | 15.93                   |                  | 1.94             | 28.25             | 0.190                 |                  |  |  |
| YVONNE | 18.77                   | 6.26             | 80.63            | 658.00            | 0.196                 |                  |  |  |
| TOM    | 11.49                   |                  |                  | 0.73              |                       |                  |  |  |
| VAN    | 7.11                    |                  |                  | 0.73              |                       |                  |  |  |
| BRUCE  | 9.32                    |                  | 0.88             | 9.75              |                       |                  |  |  |
| CLYDE  | 11.19                   |                  |                  | 0.27              |                       |                  |  |  |
| DAVID  | 17.59                   |                  | 0.34             | 1.11              | 0.0005                |                  |  |  |
| DAVID  | 10.69                   |                  | 0.37             | 4.82              |                       |                  |  |  |
| DAVID  | 13.02                   |                  | 0.31             | 5.80              |                       |                  |  |  |
| DAVID  | 16.33                   |                  | 0.56             | 2.01              |                       |                  |  |  |
| REX    | 6.94                    |                  |                  | 0.49              |                       |                  |  |  |
| ELMER  | 13.60                   |                  | 0.27             | 2.40              |                       |                  |  |  |
| ELMER  | 11.83                   |                  | 0.62             | 1.47              |                       |                  |  |  |
| WALT   | 6.99                    |                  |                  | 1.44              |                       |                  |  |  |
| FRED   | 10.36                   |                  | 0.23             | 0.65              | 0.0006                |                  |  |  |
| FRED   | 7.14                    |                  | 0.81             | 3.80              |                       |                  |  |  |
| GLENN  | 12.84                   |                  | 1.54             | 0.64              |                       |                  |  |  |
| GLENN  | 13.74                   |                  | 1.34             | 0.53              |                       |                  |  |  |
| HENRY  | 12.64                   |                  |                  | 0.19              |                       |                  |  |  |
| HENRY  | 9.42                    |                  |                  | 0.52              |                       |                  |  |  |
| KEITH  | 15.52                   |                  | 0.64             | 0.43              |                       |                  |  |  |
| IFROV  | 13 20                   |                  | 3 74             | 1 90              |                       |                  |  |  |

Table 61 (continued).

| Island | Mean <sup>137</sup> Cs concentrat  | ion, pCi/g, dry wt |  |
|--------|------------------------------------|--------------------|--|
|        | Messerschmidia                     | Scaevola           |  |
| IRENE  | 93.84                              | 51.29              |  |
| JANET  | 299.79                             | 183.16             |  |
| YVONNE | 1152.53 <sup>a</sup>               | 219.61             |  |
|        | Mean <sup>90</sup> Sr concentratio | on, pCi/g, dry wt  |  |
|        | Messerschmidia                     | Scaevola           |  |
| IRENE  | 82.20                              | 57.21 <sup>b</sup> |  |
| JANET  | 61.51                              | 33.29              |  |
| YVONNE | 53.96                              | 40.72              |  |
|        |                                    |                    |  |

## Table 62. Mean concentrations of <sup>137</sup>Cs and <sup>90</sup>Sr in <u>Messerschmidia</u> and <u>Scaevola</u> on IRENE, JANET, and <u>YVONNE</u>.

 $^{a}One$  high value of 5644 pCi/g influences this value (N = 5, see Table 60).  $^{b}N$  = 1.

|                    |                 |                   |                  |                  |                       | · ·            |
|--------------------|-----------------|-------------------|------------------|------------------|-----------------------|----------------|
|                    |                 |                   | Activity,        | pCig,d           | ry wt                 |                |
| Island             | 40 <sub>K</sub> | <sup>137</sup> Cs | 90 <sub>Sr</sub> | <sup>55</sup> Fe | 239,240 <sub>Pu</sub> | <sup>3</sup> н |
| DAISY              | 5.65            | 7.17              | 0.195            |                  |                       |                |
| DAISY <sup>a</sup> | 45.50           |                   | 1.405            |                  |                       |                |
| IRENE <sup>a</sup> | 99 <b>.90</b>   | 5.11              | 1.610            | 86.49            |                       |                |
| IRENE              | 7.05            | 1.77              | 0.067            |                  | 0.036                 |                |
| JANET              | 8.04            | 84.68             | 0.210            |                  |                       | 0.34           |
| JANET <sup>a</sup> | 60.05           | 210.70            | 1.570            |                  |                       |                |
| MARY               | 7.52            | 14.27             | 0.136            | 1.18             |                       |                |
| MARY <sup>a</sup>  | 39.25           | 67.75             | 0.635            |                  | ~                     |                |
| MARY               | 3.75            | 5.59              | 14.140           | 76.58            |                       |                |
| NANCY              | 6.54            | 18.83             | 0.167            | 1.95             |                       |                |
| NANCY <sup>a</sup> | 73.51           | 148.80            | 1.150            | 5.95             |                       |                |
| VERA               | 5.64            | 9.30              | 0.134            |                  |                       |                |
| YVONNE             | 6.39            | 1.99              |                  |                  |                       |                |
| YVONNE             | 8.24            | 3.96              | 0.011            |                  |                       | 0.66           |
| BRUCE              | 5.93            | 0.58              |                  |                  |                       |                |
| DAVID              | 6.44            | 2.59              | 0.014            |                  |                       | 0.31           |
| DAVID              | 3.76            | 1.67              | 0.178            |                  |                       |                |
| DAVID              | 4.69            | 0.40              | 0.026            |                  |                       |                |
| DAVID <sup>a</sup> | 30.93           | 23.32             |                  |                  |                       |                |
| ELMER              | 9.73            | 2.14              | 0.032            |                  |                       | 0.31           |
| ELMER              | 5.50            | 3.45              |                  |                  |                       |                |
| FRED               | 6.39            | 2.39              | 0.029            |                  |                       | 0.39           |
| FRED               | 5.59            | 0.53              | 0.367            |                  |                       |                |
| GLENN              | 7.53            | 1.65              | 0.326            |                  |                       |                |
| GLENN              | 6.12            | 0.86              | 0.020            |                  |                       |                |
| GLENN              | 8.28            | 1.30              |                  |                  |                       |                |
| HENRY              | 3.95            | 0.70              |                  |                  |                       |                |
| KEITH              | 7.69            | 0.95              |                  |                  |                       |                |
| LEROY              | 4.12            | 3.54              | 0.189            |                  |                       |                |
|                    |                 |                   |                  |                  |                       |                |

Table 63. Radionuclide concentrations in <u>Cocos nucifera</u> collected at Enewetak Atoll, 1972-1973.

<sup>a</sup>Milk.

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|                    | Activity, pCi/g, dry wt |                   |                  |                  |                       |                  |  |
|--------------------|-------------------------|-------------------|------------------|------------------|-----------------------|------------------|--|
| Island             | 40 <sub>K</sub>         | 137 <sub>Cs</sub> | <sup>60</sup> Co | 90 <sub>Sr</sub> | 239,240 <sub>Pu</sub> | <sup>55</sup> Fe |  |
| KATE               | 14.50                   | 34.09             |                  | 23.56            | 0.0010                |                  |  |
| MARY               | 16.27                   |                   |                  | 45.05            | 0.0340                |                  |  |
| MARY <sup>a</sup>  | 12.45                   | 192.30            |                  | 4.01             | 0.0120                |                  |  |
| MARY <sup>a</sup>  | 13.45                   | 97.43             | 0.057            | 3.35             | 0.0022                |                  |  |
| NANCY              | 11.16                   | 55.05             |                  | 43.47            | 0.0056                |                  |  |
| OLIVE <sup>a</sup> | 18.74                   | 30.42             |                  | 4.48             |                       |                  |  |
| OLIVE              | 12.48                   | 66.58             | 0.33             | 37.66            | 0.011                 | 0.063            |  |
| OLIVE              | 18.73                   | 29.57             |                  | 39.50            |                       |                  |  |
| TILDA              | 13.94                   | 13.90             |                  | 12.48            |                       |                  |  |
| VERA               | 10.46                   | 12.12             |                  | 11.85            |                       |                  |  |
| DAVID              | 12.82                   | 4.10              |                  | 0.02             | 0.013                 |                  |  |
| GLENN              | 22.29                   | 0.64              |                  | 1.58             |                       |                  |  |
| GLENN              | 19.16                   | .58               |                  | 0.40             |                       |                  |  |
| HENRY              | 17.50                   | 1.26              |                  | 0.32             |                       |                  |  |
| IRWIN              | 6.99                    | 0.33              |                  |                  |                       |                  |  |
| JAMES              | 16.99                   | 2.23              |                  | 1.85             |                       |                  |  |

Table 64.Radionuclide concentrations in Morinda citrifolia collected at<br/>Enewetak Atoll, 1972-1973.

<sup>a</sup>Fruit.

Table 65.Radionuclide concentrations in Guettarda speciosa collected at<br/>Enewetak Atoll, 1972-1973.

|        | · <u> </u>      | Activity, pCi/g, dry wt |                  |                       |                  |  |
|--------|-----------------|-------------------------|------------------|-----------------------|------------------|--|
| Island | 40 <sub>K</sub> | 137 <sub>Cs</sub>       | <sup>90</sup> Sr | 239,240 <sub>Pu</sub> | <sup>60</sup> Co |  |
| ALICE  | 11.03           | 7.41                    |                  |                       |                  |  |
| BELLE  | 12.48           | 109.10                  | 152.7            |                       |                  |  |
| IRENE  | 8.14            | 27.33                   | 53.6             |                       | 9.18             |  |
| MARY   | 7.70            | 98.69                   | 36.85            |                       |                  |  |
| NANCY  | 8.79            | 8.73                    | 30.86            | 0.0097                |                  |  |
| TILDA  | 10.10           | 5.90                    | 12.57            | 0.0091                |                  |  |
| URSULA | 14.23           | 13.27                   | 7.30             |                       |                  |  |
| WILMA  | 10.60           | 3.14                    |                  |                       |                  |  |
| YVONNE | 11.15           | 795.00                  | 64.40            | 0.0253                | 4.52             |  |
| DAVID  | 3.99            | 3.16                    | 0.32             |                       |                  |  |
| WALT   | 9.82            | 0.18                    |                  |                       |                  |  |
| JAMES  | 13.74           | 0.68                    |                  |                       |                  |  |
| KEITH  | 12.87           | 0.47                    | 1.74             |                       |                  |  |

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|              |                 |                   | Activity, c      | , pCi'g, dry wt  |                       |                  |  |
|--------------|-----------------|-------------------|------------------|------------------|-----------------------|------------------|--|
| . land       | 40 <sub>K</sub> | <sup>137</sup> Cs | <sup>60</sup> Co | <sup>90</sup> Sr | 239,240 <sub>Pu</sub> | <sup>55</sup> Fe |  |
| ISTATE       | 9.59            | 221.10            | 3.85             | 23.60            | 0.0045                |                  |  |
| NANCY        | 16.51           | 43.87             | 0.24             | 36.67            | 0.0195                |                  |  |
| VERA         | 28,58           | 56.94             |                  | 23.11            |                       |                  |  |
| BRUCE        | 17.76           | 1.46              |                  | 0.50             |                       |                  |  |
| VAN          | 12.92           | 1.99              | 0.17             |                  |                       |                  |  |
| DAVID        | 19.02           | 3.12              |                  | 0.77             | 0.0013                |                  |  |
| DAVID        | 18.10           | 1.67              |                  | 0.61             |                       |                  |  |
| DAVID        | 10.2            | 1.80              |                  | 0.56             | 0.0002                |                  |  |
| REX          | 16.00           | 2.64              | 0.091            |                  |                       |                  |  |
| GLENN        | 25.79           | 1.86              |                  | 2.88             |                       | 0.81             |  |
| GLENN        | 30.28           | 3.91              |                  | 1.74             |                       |                  |  |
| GLENN (wood) | 7.26            | 0.37              |                  |                  |                       |                  |  |
| IRWIN        | 21.77           | 1.88              |                  | 0.59             | 0.0015                |                  |  |
| JAMES        | 12.66           | 1.55              |                  |                  |                       |                  |  |
| KEITH        | 30.81           | 3.65              |                  | 3.00             |                       |                  |  |
| LEROY        | 34.27           | 10.17             |                  | 14.86            |                       |                  |  |
|              |                 |                   |                  |                  |                       |                  |  |

Table 66. Radionuclide concentrations in <u>Pisonia grandis</u> collected at Enewetak Atoll, 1972-1973.

 Table 67. Radionuclide concentrations in Pandanus tectorius collected at Enewetak Atoll, 1972-1973.

|                | Activity, pCi/g, dry wt |                   |                  |                                    |                  |                |  |  |
|----------------|-------------------------|-------------------|------------------|------------------------------------|------------------|----------------|--|--|
| Island         | <sup>40</sup> K         | <sup>137</sup> Cs | <sup>90</sup> Sr | <sup>239</sup> , <sup>240</sup> Pu | <sup>55</sup> Fe | <sup>3</sup> H |  |  |
| BELLE (fruit)  | 14.38                   | 923.00            | 206.30           |                                    |                  | 0.86           |  |  |
| BELLE (leaves) | 6.70                    | 679.30            |                  |                                    | 0.438            |                |  |  |
| JANET (leaves) | 8.12                    | 0.62              | 4.41             |                                    |                  |                |  |  |
| SALLY (leaves) | 14.02                   | 14.98             | 1.97             | 0.015                              | 0.703            |                |  |  |
| TILDA (leaves) | 13.29                   | 152.20            | 15.50            | 0.0069                             | 2.94             |                |  |  |
| VERA (leaves)  | 9.17                    | 17.58             | 4.24             | 0.0076                             |                  |                |  |  |
| DAVID (leaves) | 9.74                    | 15.0              | 3,56             |                                    | 0.13             |                |  |  |
| ELMER (leaves) | 8.86                    | 3.09              | 25.14            | 0.0020                             | 0.41             |                |  |  |
| FRED (leaves)  | 3.38                    | 4.29              | 0.42             | 0.0077                             | 0.85             |                |  |  |
| KEITH (leaves) | 12.70                   | 0.86              | 13.11            |                                    | 12.2             | 2 0            |  |  |
| KEITH (leaves) | 8.18                    | 0.57              |                  |                                    | 0.36             |                |  |  |
| LEROY (leaves) | 7.99                    | 9.14              | 1.69             | 0.0022                             | 0.21             |                |  |  |
| LEROY (fruit)  | 30.2                    | 26.2              | 16.26            |                                    |                  |                |  |  |

|                           |                                | Activity, pCi'g, dry wt |                   |                  |                 |                       |                |  |
|---------------------------|--------------------------------|-------------------------|-------------------|------------------|-----------------|-----------------------|----------------|--|
| Island                    |                                | 40 <sub>K</sub>         | <sup>137</sup> Cs | <sup>60</sup> Co | <sup>0</sup> Sr | 239,240 <sub>Pu</sub> | <sup>3</sup> H |  |
| HELEN <sup>a</sup>        | Lepturus repens                | 4.90                    | 2.51              | 0.94             | 1.44            | 0.0435                |                |  |
| <b>IRENE</b> <sup>a</sup> | Lepturus repens                | 1.95                    | 2.57              | 0.26             | 1.15            | 0.0112                |                |  |
| IRENE <sup>b</sup>        | Fimbristylis<br>atollensis     | 4.87                    | 55,00             | 14.70            | 4.42            | 0.87 <b>80</b>        |                |  |
| IRENE <sup>C</sup>        | <u>Suriana</u><br>maritima     | 5.59                    | 26.34             | 121.30           | 8.51            | 0.0286                |                |  |
| JANET <sup>C</sup>        | <u>Pluchea</u> odorata         | 10.80                   | 1553.00           | 1.25             | 46.85           |                       |                |  |
| MARY <sup>a</sup>         | Lepturus repens                |                         | 105.70            |                  | 17.39           | 0.0093                |                |  |
| SALLY <sup>a</sup>        | Lepturus repens                | 3.74                    | 83.20             |                  | 1.98            | 0.0227                |                |  |
| david <sup>d</sup>        | Tacca<br>leontopetaloides      | 6.63                    | 1.09              |                  | 0.46            | 0.0011                | 0.52           |  |
| da vid <sup>b</sup>       | Fimbristylis<br>atollensis     | 3.38                    | 7.40              |                  |                 |                       |                |  |
| henry <sup>a</sup>        | Lepturus repens                | 11.29                   | 0.10              |                  | 0,059           | 0.0021                |                |  |
| IRWIN <sup>C</sup>        | <u>Terminalia</u><br>samoensis | 11.36                   | 0.77              |                  | 0.932           | 0.0013                |                |  |

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 Table 68. Radionuclide concentrations in miscellaneous plant species collected at Enewetak Atoll, 1972-1973.

<sup>a</sup>Grass. cShrub. bSedge. dHerb.

|                       |                 | · · · · · · · · · · · · · · · · · · · | Activi           | ty nCi/a            | dry wit              |                  |                |
|-----------------------|-----------------|---------------------------------------|------------------|---------------------|----------------------|------------------|----------------|
|                       |                 |                                       |                  | cy, per g,          | , ury wi             |                  |                |
| Island/organ          | 40 <sub>K</sub> | <sup>60</sup> Co                      | 90 <sub>Sr</sub> | 137 <sub>Cs</sub> 2 | 39,240 <sub>Pl</sub> | <sup>55</sup> Fe | <sup>3</sup> H |
| LUCY                  |                 |                                       |                  |                     |                      |                  |                |
| Hepatop. <sup>b</sup> | 10.42           | 2.95                                  |                  | 125.70              |                      |                  |                |
| Exoskel. <sup>C</sup> |                 | 0.97                                  |                  | 39.15               |                      |                  |                |
| IRENE                 |                 |                                       |                  |                     |                      |                  |                |
| Hepatop.              | 7.04            | 82.80                                 | 29.60            | 124.30              | 0.196                | 12.8             | 0.58           |
| Muscle                | 7.36            | 62.40                                 | 22.6             | 130.70              | 0.069                | 3.32             |                |
| Exoskel.              | 1.94            | 1.66                                  |                  | 27.20               | 0.017                | 0.32             |                |
| DAVID                 |                 |                                       |                  |                     |                      |                  |                |
| Hepatop.              | 7.61            | 0.23                                  | 0.19             | 1.95                | 4.82                 | 0.57             | 0.95           |
| Muscle                | 7.52            | 0.28                                  | 0.33             | 2,06                | 0.0031               |                  | 0.58           |
| Exoskel.              | 1.76            |                                       | 4.05             | 0.60                | 0.010                | 0.039            |                |
| REX                   |                 |                                       |                  |                     |                      |                  |                |
| Hepatop.              | 5.83            | 0.57                                  | 0.30             | 2.06                | 0.0031               | 1.82             |                |
| Muscle                | 6.68            | 1.44                                  | 0.32             | 1.05                | 0.0026               | 1.47             |                |
| Exoskel.              | 1.84            |                                       | 3.62             | 0.25                | 0,001                | 0.085            |                |
| GLENN                 |                 |                                       |                  |                     |                      |                  |                |
| Hepatop.              | 8.68            | 1.12                                  | 0.43             | 1.51                | 0.006                | 1.55             |                |
| Muscle                | 7.86            | 1.97                                  | 0.91             | 1.51                | 0.011                | 1.32             |                |
| Exoskel.              | 1.52            |                                       | 9.14             | 0.25                | 0.001                |                  |                |
| HENRY                 |                 |                                       |                  |                     |                      |                  |                |
| Hepatop.              | 5.72            | 0.98                                  | 0.50             | 1.17                |                      |                  |                |
| Muscle                | 7.69            | 2.00                                  | 0.64             | 1.08                | 0.0066               | 0.98             |                |
| Exoskel.              | 2.34            |                                       | 9.64             | 0.24                |                      | 0.08             |                |
| IRWIN                 |                 |                                       |                  |                     |                      |                  |                |
| Hepatop.              | 7,75            | 0.89                                  | 0.45             | 0.58                | 0.0053               | 1.78             |                |
| Muscle                | 6.74            | 1.77                                  | 0.31             | 0.55                | 0.0125               | 0.75             |                |
| Exoskel.              | 2.73            |                                       | 4.78             | 0.01                | 0.0008               | 0.11             |                |
|                       |                 |                                       |                  |                     |                      |                  |                |

Table 69. Radionuclide concentrations in <u>Coenobita</u> (hermit crab)<sup>a</sup> at Enewetak Atoll, 1972-1973.

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<sup>a</sup>Collection contained both <u>C. perlatus</u> and <u>C. brevimannus</u>. <sup>b</sup>Hepatopancreas/gonad. <sup>c</sup>Exoskeleton.

|                | Activity, pCi/g, dry wt |                  |                  |                   |                       |                  |                |  |  |  |  |
|----------------|-------------------------|------------------|------------------|-------------------|-----------------------|------------------|----------------|--|--|--|--|
| Island organ   | 40 <sub>K</sub>         | <sup>60</sup> Со | 90 <sub>Sr</sub> | 137 <sub>Cs</sub> | 239,240 <sub>Pu</sub> | <sup>55</sup> Fe | <sup>3</sup> н |  |  |  |  |
| BRUCE          |                         |                  |                  |                   |                       |                  |                |  |  |  |  |
| Muscle         | 11.28                   | 0.20             | 0.18             | 1.98              |                       | 0.98             | 0.42           |  |  |  |  |
| Exoskeleton    | 2.59                    |                  | 6.08             | 0.29              | 0.001                 | 0.07             |                |  |  |  |  |
| Hepatopancreas | 3.02                    | 0.40             | 0.13             | 0.42              |                       | 5.70             | 0.16           |  |  |  |  |
| GLENN          |                         |                  |                  |                   |                       |                  |                |  |  |  |  |
| Muscle         | 10.45                   |                  |                  | 1.88              |                       | 0.68             | 0.69           |  |  |  |  |
| Exoskeleton    | 1.06                    |                  | 10.4             | 0.31              | 0.0035                |                  |                |  |  |  |  |
| Hepatopancreas | 2.34                    | 0.27             |                  | 0.54              |                       |                  | 0.27           |  |  |  |  |
| JAMES          |                         |                  |                  |                   |                       |                  |                |  |  |  |  |
| Muscle         | 9.62                    | 1.05             | 0.079            | 1.25              |                       | 1.84             |                |  |  |  |  |
| Exoskeleton    | 1.44                    | 0.11             | 5.9              | 0.22              | 0.002                 | 0.30             |                |  |  |  |  |
| Hepatopancreas | 4.00                    | 1.56             |                  | 0.32              |                       | 12.8             |                |  |  |  |  |
| KEITH          |                         |                  |                  |                   |                       |                  |                |  |  |  |  |
| Muscle         | 10.11                   | 0.42             | 1.19             | 1.92              |                       | 1.46             |                |  |  |  |  |
| Exoskeleton    | 3.35                    |                  | 9.96             | 0.51              | 0.007                 | 6.18             |                |  |  |  |  |
| Hepatopancreas | 3.20                    | 1.03             | 0.40             | 0.50              | 0.0098                | 6.17             |                |  |  |  |  |
| LEROY          |                         |                  |                  |                   |                       |                  |                |  |  |  |  |
| Muscle         | 8.80                    | 1.23             | 1.58             | 12.60             | 0.0031                | 1.59             | 0.88           |  |  |  |  |
| Exoskeleton    | 1.58                    | 0.17             | 89.6             | 2.52              | 0.025                 | 0.17             |                |  |  |  |  |
| Hepatopancreas | 2.55                    | 0.84             | 2.58             | 3.85              | 0.0038                | 5.05             |                |  |  |  |  |

Table 70.Radionuclide concentrations in Birgus latro (coconut crab)collected at Enewetak Atoll, 1972-1973.

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|              |                  | Activity, pCi/g, dry wt |                  |                  |                  |                       |  |  |  |  |
|--------------|------------------|-------------------------|------------------|------------------|------------------|-----------------------|--|--|--|--|
| icland/organ | 40 <sub>K</sub>  | <sup>137</sup> Cs       | <sup>60</sup> Со | 90 <sub>Sr</sub> | <sup>55</sup> Fe | 239,240 <sub>Pu</sub> |  |  |  |  |
| PEARL        |                  |                         |                  |                  |                  |                       |  |  |  |  |
| Liver        | 32.33            | 33.30                   | 5.07             | 164.90           | 82.0             | 0.012                 |  |  |  |  |
| Viscera      |                  | 30.80                   | 7.45             | 1.79             |                  | 1.77                  |  |  |  |  |
| Muscle       | 11.60            | 37.07                   | 0.89             | 0.37             | 23.2             | 0.117                 |  |  |  |  |
| Bone         | 9.57             | 53,60                   | 2.59             | 36.1             |                  |                       |  |  |  |  |
| SALLY        |                  |                         |                  |                  |                  |                       |  |  |  |  |
| Liver        | 10.73            | 63.83                   | 2.54             | 0.002            | 35.5             | 0.008                 |  |  |  |  |
| Viscera      | <sup>9</sup> .63 | 92.97                   | 1.48             | 14.6             |                  | 1.30                  |  |  |  |  |
| Muscle       | 5.82             | 60.86                   |                  |                  |                  |                       |  |  |  |  |
| Bone         | 7.01             | 65.77                   | 0.81             | 25.9             |                  | 0.039                 |  |  |  |  |
| URSULA       |                  |                         |                  |                  |                  |                       |  |  |  |  |
| Liver        | 6.72             | 39.41                   | 3.59             |                  | 42.2             | 0.041                 |  |  |  |  |
| Viscera      | 10.87            | 43.14                   | 1.13             | 2.17             |                  |                       |  |  |  |  |
| Muscle       | 9.22             | 37.86                   |                  |                  |                  |                       |  |  |  |  |
| Bone         | 7.26             | 61.58                   |                  | 19.6             |                  | 0.146                 |  |  |  |  |
| DAVID        |                  |                         |                  |                  |                  |                       |  |  |  |  |
| Viscera      | 12.24            | 21.97                   |                  | 0.24             |                  | 0.0087                |  |  |  |  |
| Liver        |                  | 16.36                   |                  |                  | 3.67             | 0.004                 |  |  |  |  |
| Muscle       | 7.80             | 18.78                   |                  | 0.60             | 0.98             | 0.044                 |  |  |  |  |
| Bone         | 11.46            | 28.37                   |                  | 1.37             |                  | 0.065                 |  |  |  |  |
| Skin         | 6.49             | 9.13                    |                  |                  |                  |                       |  |  |  |  |
| Kidney       |                  | 17.0                    |                  |                  |                  |                       |  |  |  |  |
| Lung         |                  | 18.5                    |                  |                  |                  | 0.031                 |  |  |  |  |
| GLENN        |                  |                         |                  |                  |                  |                       |  |  |  |  |
| Liver        | 12.79            | 1.45                    | 1.81             |                  | 19.28            | 0.035                 |  |  |  |  |
| Muscle       | 8.18             | 1.76                    | 0.48             | 1.03             | 4.49             | 0.017                 |  |  |  |  |
| Viscera      | 11.75            | 1.88                    | 2.06             | 0.28             |                  | 0.036                 |  |  |  |  |
| Bone         | 10.61            | 6.02                    | 0.71             | 2.67             |                  | 0.87                  |  |  |  |  |
| Skin         | 2.3              | 0.33                    |                  |                  |                  |                       |  |  |  |  |
| Kidney       |                  | 1.46                    | 2.40             |                  |                  |                       |  |  |  |  |
| Lung         | 20.7             | 1.74                    |                  |                  |                  | 0.30                  |  |  |  |  |

Table 71. Distribution of radionuclides in <u>Rattus exulans</u> (rice rat) collected at Enewetak Atoll, 1972-1973.

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|                      | Activity, pCi/g, dry wt |                   |                  |                  |                 |                       |                |  |
|----------------------|-------------------------|-------------------|------------------|------------------|-----------------|-----------------------|----------------|--|
| Island/organ         | 40 <sub>K</sub>         | <sup>137</sup> Cs | <sup>60</sup> Co | 90 <sub>Sr</sub> | $\frac{55}{Fe}$ | 239,240 <sub>Pu</sub> | <sup>3</sup> H |  |
| JANET                |                         |                   |                  |                  |                 |                       |                |  |
| Viscera <sup>a</sup> | 12.63                   | 880.60            | 2.35             | 14.14            |                 | 0.46                  |                |  |
| Muscle <sup>a</sup>  | 8.74                    | 764.00            | 0.29             | 1.28             | 30.9            |                       |                |  |
| Liver <sup>a</sup>   | 13.42                   | 632.90            | 3.23             | 0.004            | 77.9            |                       |                |  |
| Bone <sup>a</sup>    | 8.69                    | 661.20            | 0.30             | 115.8            |                 | 0.26                  |                |  |
| Viscera              | 11.38                   | 768.00            | 1.97             | 6.85             |                 | 0.36                  |                |  |
| Muscle               |                         | 696.80            | 0.41             | 3.44             | 8.69            | 0.0073                |                |  |
| Liver                | 18.17                   | 604.10            | 3.97             |                  | 30.9            |                       |                |  |
| Bone                 | 5.97                    | 357.20            |                  | 133.8            |                 | 0.17                  |                |  |
| Viscera              | 16.23                   | 954.50            | 4.95             | 55.86            | 24.32           | 0.729                 |                |  |
| Liver                | 33.00                   | 741.90            | 2.56             | 0.01             | 105.4           |                       |                |  |
| Bone                 | 10.32                   | 545.50            | 0.45             | 324.3            |                 | 0.168                 |                |  |
| Viscera              |                         | 273.20            | 1.72             |                  |                 |                       |                |  |
| Muscle               |                         | 286.50            | 0.23             | 2.29             | 10.5            | 0.0097                |                |  |
| Liver                |                         | 211.5             | 2.21             | 0.07             | 24.4            |                       |                |  |
| Bone                 | 9.06                    | 129.20            | 0.22             | 68.92            |                 | 0.0302                |                |  |
| Viscera              | 18.54                   | 999.50            | 2.93             | 8.74             |                 | 0.410                 |                |  |
| Muscle               | 13.87                   | 765.80            | 0.64             | 3.14             | 16.3            | 0.0023                |                |  |
| Liver                |                         | 897.70            | 6.31             | 0.007            | 86.9            | 0.018                 |                |  |
| Bone                 |                         | 6 <b>27.</b> 50   | 0.51             | 121.2            |                 | 3.250                 |                |  |
| BRUCE                |                         |                   |                  |                  |                 |                       |                |  |
| Skin                 | 8.07                    | 0.61              |                  |                  |                 |                       |                |  |
| Kidney               |                         |                   | 3.19             |                  |                 |                       |                |  |
| Lung                 | 35.9                    |                   |                  |                  |                 |                       |                |  |
| Viscera              |                         | 1.09              |                  |                  |                 | 0.035                 |                |  |
| Muscle               | 5.21                    | 1.47              |                  | 0.07             | 2.21            | 0.009                 |                |  |
| Liver                | 30.20                   | 1.07              | 1.62             |                  | 46.40           | 0.013                 |                |  |
| Bone                 | 18.81                   | 13.25             |                  | 1.69             |                 | 3.278                 |                |  |

Table 72. Distribution of radionuclides in <u>Rattus</u> rattus (roof rat) collected on Enewetak Atoll, 1972-1973.

<sup>a</sup>Collected by Enewetak Marine Biological Laboratory personnel, February, 1973.

| Table 72 (cont | inued).        |          |                                       |           |                 |                       |         |                         |
|----------------|----------------|----------|---------------------------------------|-----------|-----------------|-----------------------|---------|-------------------------|
| 1              |                |          | · · · · · · · · · · · · · · · · · · · | Activity, | pCi/g           | dry wt                |         |                         |
|                | 40,,           | 137      | 60 <sub>Ca</sub>                      | 90        | 55 <sub>5</sub> | 239,240 <sub>Du</sub> | 3,11    | Other                   |
| Island/organ   | K              | <u> </u> |                                       | 51        | Fe              | ru                    | <u></u> | Other                   |
| ELMER          | 11 10          | 10.00    | 1 20                                  | 0 10      |                 | 0 0074                |         |                         |
| Viscera        | 11.19          | 18.98    | 1.39                                  | 0.10      | 0 10            | 0.0074                | 11 2    |                         |
| Muscle         | 10.30          | 18.40    |                                       | 0.05      | 0.10            | 0.016                 | 11.0    |                         |
| Liver          | 11.12          | 15.60    |                                       | 0.02      | 0.93            |                       |         |                         |
| Bone           | 9.04           | 9.96     |                                       | 1.42      |                 | 0.23                  |         |                         |
| Skin           | 6.50           | 7.60     |                                       |           |                 |                       |         |                         |
| Lung           | 14.7           | 16.90    |                                       | 1.0       |                 | 0.14                  |         |                         |
| Kidney         | 21.8           | 15.0     | 1.74                                  |           |                 |                       |         |                         |
| YVONNE, Sec    | ctor A         |          |                                       |           |                 |                       |         |                         |
| Muscle         | 12.35          | 4240.00  | 12.35                                 | 5.09      | 32.80           | 0.052                 | 1.8     |                         |
| Bone           |                | 1833.00  | 5.92                                  | 146.40    |                 | 0.057                 |         | $^{134}$ Cs 1.12        |
| Viscera        | 7.61           | 2928.00  | 112.60                                |           |                 | 1.05                  |         | <sup>134</sup> Cs 1.90  |
| Skin           | 6.69           | 2088.00  | 14.00                                 |           |                 |                       |         |                         |
| Liver          |                | 2559.00  | 7.03                                  |           | 126.10          | 0.027                 |         | <sup>151</sup> Sm 18.70 |
| Kidney         |                | 3427.00  | 257.70                                |           |                 |                       |         |                         |
| Lung           | 14.26          | 3306.00  | <b>10.</b> 53                         | 0.24      |                 | 0.107                 |         |                         |
| Muscle         | 13.07          | 3824.00  | 8.51                                  | 37.79     | 78.83           | 0.003                 | ~~      |                         |
| Bone           | 7.93           | 2199.00  | 10.57                                 | 135.10    |                 | 0.29                  |         |                         |
| Viscera        | 13.33          | 3531.00  | 230.00                                | 4.09      |                 | 0.581                 |         |                         |
| Skin           | 6.92           | 1875.00  | 7.43                                  |           |                 |                       |         |                         |
| Liver          | 14.15          | 2215.00  | 86.13                                 | 0.005     | 135.60          | 0.013                 |         |                         |
| Kidney         |                | 3286.00  | 261.80                                |           |                 |                       |         |                         |
| Lung           | 33.12          | 2760.00  | 11.08                                 | 16.17     |                 |                       |         |                         |
| YVONNE, Se     | c <b>tor</b> B |          |                                       |           |                 |                       |         |                         |
| Muscle         | 16.82          | 86.04    |                                       |           |                 |                       |         |                         |
| Bone           | 9.74           | 48.78    | 0.33                                  | 16.67     |                 | 0.304                 |         |                         |
| Viscera        | 9.67           | 76.71    | 1.99                                  | 0.57      |                 | 0.393                 |         |                         |
| Skin           | 4.74           | 42.64    |                                       |           |                 |                       |         |                         |
| Liver          |                | 56.22    | 2.90                                  |           | 25.01           | 0.008                 |         | <sup>151</sup> Sm 23.00 |
| Kidney         |                | 59.64    | 4.95                                  |           |                 |                       |         |                         |
| Lung           |                | 39.72    |                                       |           |                 |                       |         |                         |
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| Table ' | 72 ( | continued). | • |
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|              |                 |                   |                  | Activity         | , pCi/g | , dry wt              |                |                 |
|--------------|-----------------|-------------------|------------------|------------------|---------|-----------------------|----------------|-----------------|
| Island/organ | 40 <sub>K</sub> | <sup>137</sup> Cs | <sup>60</sup> Co | <sup>90</sup> Sr | 55Fe    | 239,240 <sub>Pu</sub> | <sup>3</sup> н | Other           |
| YVONNE, Se   | ctor C          |                   |                  |                  |         |                       |                | -01             |
| Skin         |                 | 29.39             | 0.69             |                  |         |                       |                | -               |
| Lung         |                 | 53.33             |                  |                  |         | 0.568                 |                | 1               |
| Viscera      |                 | 55.81             |                  |                  | 3.46    | 0.211                 |                | 238<br>Pu 0 00c |
| Liver        |                 | 38.68             | 5.63             | 0.002            | 13.83   | 0.011                 |                | - 0.036         |
| Kidney       | 30.64           | 29.00             | 8.03             |                  |         |                       |                | ~               |
| Muscle       | 5.77            | 49.19             | 0.55             | 6.76             | 4.12    |                       |                |                 |
| Bone         |                 | 38.78             | 0.51             | 6.40             |         | 0.058                 |                |                 |
| YVONNE, Se   | ctor D          |                   |                  |                  |         |                       |                |                 |
| Muscle       | 15.87           | 3.74              |                  | 0.63             | 1.23    | 0.008                 |                |                 |
| Bone         | 23.95           | 23.80             | 1.32             |                  |         | 0.058                 |                |                 |
| Lung         |                 | 11.55             |                  |                  |         | 0.201                 |                |                 |
| Viscera      | 17.77           | 5.69              | 0.20             |                  |         | 0.020                 |                |                 |
| Liver        |                 | 4.62              |                  | 10.54            | 17.30   | 0.398                 |                |                 |

Table 73.

Common n (<u>Anous sto</u> ALICE IRENE JANET LUCY MARY YVONN

> VAN REX IRWIN KEITH

White-capp (<u>Anous tem</u> SALLY BRUCE LEROY

Sooty tern (<u>Sterna fusc</u> SALLY CLYDE DAVID

Pooled tern JANET

| -                              |             |        |                  | Activ    | ity, pCi | /g, dry v | wt     |                     |          |       |
|--------------------------------|-------------|--------|------------------|----------|----------|-----------|--------|---------------------|----------|-------|
|                                |             |        | <sup>90</sup> Sr |          |          |           | 23     | 9,240 <sub>Pu</sub> |          |       |
|                                | Liver       | Muscle | Bone             | Eggshell | Egg      | Liver     | Muscle | Egg                 | Eggshell | Bone  |
| Common noddy                   |             |        |                  |          |          |           |        |                     |          |       |
| (Anous stolidus)               |             |        |                  |          |          |           |        |                     |          |       |
| ALICE                          |             | 0.01   | 20.6             |          |          | 0.06      |        |                     |          |       |
| IRENE (                        | 0.51        |        |                  | 7.34     | 0.095    | 0.009     |        | 0.0015              | 0.0081   |       |
| JANET                          | 0.066       | 0.008  | 0.39             | 16.04    | 0.203    |           | 0.0018 | 0.0148              |          |       |
| LUCY                           | 0.187       |        | 0.71             |          |          |           | 0.022  |                     |          |       |
| MARY                           |             | 0.48   |                  |          |          |           |        |                     |          |       |
| YVONNE                         |             | 0.0073 |                  | 0.49     | 1.06     |           | 0.02   | 0.0232              | 0.0086   | 0.021 |
|                                |             |        |                  | 0.22     | 0.073    |           |        |                     |          |       |
| VAN                            | 0.04        | 0.04   | 0.143            |          | 0.002    |           | 0.0014 | 0.00047             | ,        |       |
| REX                            |             | 0.0065 |                  |          |          |           | 0.0056 | 0.00077             |          |       |
| IRWIN                          | 0.23        |        |                  |          |          | 0.0242    | 0.0434 | 0.00088             | 3        |       |
| KEITH                          |             |        |                  |          |          |           | 0.001  |                     |          |       |
| White-capped node              | dy<br>ic)   |        |                  |          |          |           |        |                     |          |       |
| (Anous tenuirostri             | <u>(5</u> ) |        |                  |          |          | 0 011     | 0 005  |                     |          |       |
| SALLY                          |             |        | 0 66             |          |          | 0.011     |        |                     |          |       |
| BRUCE                          |             |        | 0.00             |          |          | 0 0070    | 0.0069 |                     |          |       |
| LEROY                          | 0.402       |        |                  |          |          | 0.0072    | 0.0033 |                     |          |       |
| Sooty tern<br>(Sterna fuscata) |             |        |                  |          |          |           |        |                     |          |       |
| SALLY                          |             |        | 1.68             | 0.265    | 0.0042   |           |        |                     |          | 0.005 |
| CLYDE                          | 0.015       | 0.0063 |                  |          |          | 0.0017    |        |                     |          |       |
| DAVID                          |             |        |                  |          |          |           | 0.119  |                     |          |       |
| Pooled terns                   |             |        |                  |          |          |           |        |                     |          |       |
| JANET                          |             | 0.005  |                  |          |          | 0.0015    |        |                     |          |       |

Table 73. Distribution of <sup>90</sup>Sr and <sup>239,240</sup>Pu in birds collected at Enewetak Atoll, 1972-1973.

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|                                                |                  |                 | Activi    | ty, pCi | g, dry w | 't    |               |       |              |          |       |
|------------------------------------------------|------------------|-----------------|-----------|---------|----------|-------|---------------|-------|--------------|----------|-------|
|                                                |                  | <sup>60</sup> c | <u>`o</u> |         |          |       |               |       |              |          |       |
|                                                | Viscera          | Liver           | Muscle    | Bone    | Viscera  | Liver | Muscle        | Bone  | Egg          | Eggshell | i c   |
| Common noddy<br>( <u>Anous stolidus</u> )      |                  |                 |           |         |          |       |               |       |              |          | -     |
| ALICE                                          |                  |                 | 0.32      |         | 47.3     | 127.0 | 49.55         | 25.7  |              |          |       |
| IRENE                                          |                  | 0.324           | 0.25      |         | 57.66    | 49.6  |               | 57.66 | 23.0         | 1.18     |       |
| JANET                                          |                  |                 | 0.51      |         | 64.0     | 258.  | 104.5         | 50.0  | 57.2         | 1,28     | ,     |
| LUCY                                           |                  |                 |           |         | 108.6    | 199.  | 8.78          | 38.5  |              |          |       |
| MARY                                           |                  | 0.567           |           |         | 53.6     | 2.51  | 14.2          | 59.9  |              |          |       |
| OLIVE                                          |                  |                 |           | 0.31    | 57.2     | 332.4 | 9 <b>2.</b> 8 | 46.4  |              |          |       |
| YVONNE                                         | 0.51             | 0.37            | 0.23      |         | 64.4     | 385.6 | 22.6          | 63.5  | 56.8<br>54.5 | 1.10     |       |
| Common noddy<br>(Anous stolidus)               |                  |                 |           |         |          |       |               |       |              |          |       |
| VAN                                            |                  | 0.195           | 0.29      |         | 50.5     | 279.  | 99.55         | 40.3  | 63.5         | 1.68     | ;     |
| REX                                            |                  |                 |           |         | 50.0     | 117.6 | 43.5          | 44.8  | 51.4         | 0.73     | - Ang |
| HENRY                                          |                  |                 |           |         |          |       |               |       | 54.1         | 8.56     |       |
| IRWIN                                          |                  | 0.63            |           |         | 45.95    | 423.  | 169.          | 49.1  | 5.14         |          |       |
| KEITH                                          |                  | 0.69            | 0.452     | 0.312   | 80.18    |       |               | 68.5  |              |          |       |
| White-capped not<br>(Anous tenuirost:<br>SALLY | ddy<br>ris)      |                 |           | 0.34    | 64.4     |       | 36.6          | 61.3  |              |          |       |
| BRUCE                                          |                  |                 | 0.392     |         | 73.9     | 327.  | 41.3          | 44.2  |              |          |       |
| LEROY                                          | 1.01             | 2.38            | 2.07      | 0.94    | 71.6     | 810.8 | 64.4          | 109.5 |              |          |       |
| Sooty tern<br>( <u>Sterna fuscata</u> )        |                  |                 |           |         |          |       |               |       |              |          |       |
| SALLY                                          |                  |                 |           |         | 22.4     | 155.0 |               | 35.7  | 37.6         |          | :     |
| CLYDE                                          |                  |                 |           |         | 49.1     | 146.4 | 20.4          | 36.0  |              |          |       |
| DAVID                                          |                  |                 |           |         | 63.5     | 153.  | 59.0          | 37.4  |              |          | -     |
| Pooled sample<br>(Terns, noddys,               | etc.)            |                 |           |         |          |       |               |       |              |          | 1     |
| JANET                                          |                  |                 | 0.16      |         | 52.2     | 171.6 | 59.5          | 40.0  |              |          | 1.3   |
| PEARL                                          | 0.435            | 0.647           | 0.659     |         | 61.7     |       |               | 46.9  |              |          | 7     |
| Other species:                                 |                  |                 |           |         |          |       |               |       |              |          |       |
| Red-tailed tropi<br>(Phaethon rubric           | e bird<br>cauda) |                 |           |         |          |       |               |       |              |          |       |
| KATE                                           |                  |                 |           |         |          |       |               |       |              |          |       |
| Reef heron<br>(Demigretta sac                  | <u>ra</u> )      |                 |           | 0.41    |          |       |               |       |              |          |       |

Table 74. Distribution of <sup>60</sup>Co and <sup>55</sup>Fe in birds collected at Enewetak Atoll, 1972-1973.

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|                                                 |         |       | Activ           | vity, pC | `i∕g, d | ry wt |       |                   |         |
|-------------------------------------------------|---------|-------|-----------------|----------|---------|-------|-------|-------------------|---------|
|                                                 |         |       | 40 <sub>K</sub> |          |         |       |       | 137 <sub>Cs</sub> |         |
|                                                 | Viscera | Liver | Muscle          | Bone     | Egg     |       | Bone  | Egg               | Viscera |
| Common noddy                                    |         |       |                 |          |         |       |       |                   |         |
| Anous stolidus)                                 |         |       |                 |          |         |       |       |                   |         |
| ALICE                                           |         | 10,2  | 9,66            | 5.3      |         |       | 1.16  |                   |         |
| IRENE                                           |         | 7.88  | 9.42            |          | 6.37    |       | 0.17  |                   |         |
| JANET                                           | 10.68   | 7.83  | 9.19            | 3.04     | 6.21    |       | 0.73  |                   |         |
| LUCY                                            | 13.08   |       | 12.23           |          |         |       | 7.45  |                   |         |
| MARY                                            | 11.41   | 6.63  |                 | 5.74     |         |       |       |                   |         |
| OLIVE                                           | 8.81    |       |                 | 4.07     |         |       |       |                   |         |
| YVONNE                                          | 8.34    |       | 7.39            |          | 4.53    |       | 5.51  | 0.079             |         |
|                                                 |         |       |                 |          | 4.13    |       |       |                   |         |
|                                                 |         |       |                 |          | 7.22    |       |       |                   |         |
| VAN                                             |         |       | 10.48           | 6.96     | 6.31    |       | 0.74  | 0.136             |         |
| REX                                             |         | 4.89  | 10.81           |          | 7.69    |       |       |                   |         |
| HENRY                                           |         |       |                 |          | 3.39    |       |       |                   |         |
| IRWIN                                           |         | 15.84 | 9.28            |          | 7.49    |       |       |                   |         |
| KEITH                                           | 8.97    |       | 12.96           | 3.80     |         |       |       |                   |         |
| White-capped noddy<br>(Anous tenuirostris)      |         |       |                 |          |         |       |       |                   |         |
| SALLY                                           | 5.89    |       | 6.31            |          |         |       | 0.137 |                   |         |
| BRUCE                                           |         | 8.37  | 7.09            |          |         |       |       |                   |         |
| LEROY                                           | 7.82    |       | 10.95           |          |         |       |       |                   |         |
| Sooty tern<br>(Sterna fuscata)                  |         |       |                 |          | E       | ggshe | 211   |                   |         |
| SALLY                                           | 4.79    |       |                 |          | 4.57    |       |       |                   |         |
| CLYDE                                           | 7.94    |       | 7.37            | 2.36     | 5.41    | 1.4   |       |                   |         |
| DAVID                                           | 8.90    | 20.36 | 7.46            |          |         |       | 0.745 |                   |         |
| Pooled sample<br>(terns, noddys, etc.)          |         |       |                 |          |         |       |       |                   |         |
| JANET                                           | 9.62    |       | 8.77            | 3.32     |         |       |       |                   | 0.18    |
| PEARL                                           |         |       | 8.67            |          |         |       | 0.793 |                   |         |
| ALVIN                                           |         | 20.37 | 10.44           | 10.32    |         |       | 5.71  |                   |         |
| Other species:                                  |         |       |                 |          |         |       |       |                   |         |
| Red-tailed tropic bird<br>(Phaethon rubricauda) |         |       |                 |          |         |       |       |                   |         |
| KATE                                            | 7.81    |       | 8.79            |          |         |       | 0.10  |                   |         |
| Reef heron<br>(Demigretta sacra)<br>DAVID       |         |       | 4 65            | 8 76     |         |       | 1 34  | 1 50              |         |
| Sandpiper<br>(Erolia acuminata)                 |         |       | 1.00            | 0.10     |         |       | 1.04  | 1.00              |         |
| DAVID                                           |         | 17.57 |                 | 28.16    |         |       | 0.789 |                   |         |

## Table 75. Distribution of ${}^{137}$ Cs and ${}^{40}$ K in birds collected at Enewetak Atoll, 1972-1973.

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1.68 0.73 3.56

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|                                  |                 |                   | Activity,        | pCi′g,           | dry wt                |            |
|----------------------------------|-----------------|-------------------|------------------|------------------|-----------------------|------------|
| Ecosystem level                  | 40 <sub>K</sub> | <sup>137</sup> Cs | <sup>90</sup> Sr | <sup>60</sup> Co | <sup>239,240</sup> Pu | $^{55}$ Fe |
| Soil Island range                |                 | 5.6-141           | 14-430           | 1.4-33           | 3.9-68                |            |
| Mean                             |                 | 36                | 80               | 5.9              | 12                    |            |
| Soil survey<br>Sample 15         |                 | 13.00             | 32,00            | 2.7              | 5.80                  |            |
| Biota soil sample                |                 | 69.05             | 580.20           | 100.90           | 83.78                 |            |
| Plants<br>Scaevola<br>frutescens | 12.82           | 66.53             | 32.7             |                  |                       |            |
| Messerschmidia<br>argentea       | 13.38           | 222.80            | 138.30           |                  | 0.025                 |            |
| <u>speciosa</u>                  | 11.03           | 7.40              |                  |                  |                       |            |
| Animals                          |                 |                   |                  |                  |                       |            |
| Anous stolidus<br>Common noddy   |                 |                   |                  |                  |                       |            |
| Liver                            | 10.20           |                   |                  |                  | 0.062                 | 127.0      |
| Viscera                          |                 |                   |                  |                  |                       | 47.20      |
| Muscle                           | 9.66            |                   | 0.01             | 0.32             | * = * *               | 49.55      |
| Bone                             | 5.30            | 1.16              | 20.59            |                  |                       | 25.68      |

## Table 76. Distribution of radionuclides in terrestrial biota and soils on ALICE, Enewetak Atoll, 1972-1973.

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|                                     |                 | Act               | ivity, pCi       | /g, drv          | wt                    |                  |                |
|-------------------------------------|-----------------|-------------------|------------------|------------------|-----------------------|------------------|----------------|
| Ecosystem level                     | 40 <sub>K</sub> | <sup>137</sup> Cs | <sup>90</sup> Sr | <sup>60</sup> Co | 239,240 <sub>Pu</sub> | <sup>55</sup> Fe | <sup>3</sup> H |
| Soil - Dense                        |                 |                   |                  |                  |                       |                  |                |
| Island range                        |                 | 14-170            | 14-670           | 3.1-30           | 7.2-130               |                  |                |
| Mean                                |                 | 48                | 123              | 10               | 26                    |                  |                |
| Sparse                              |                 |                   |                  |                  |                       |                  |                |
| Island range                        |                 | 3.3-44            | 35 <b>-</b> 130  | 2.4-9.           | 6 5.8-26              |                  |                |
| Mean                                |                 | 8.6               | 44               | 4.6              | 11                    |                  |                |
| Soil survey<br>Sample 32            |                 | 0.67              | 16.0             | 0.38             | 6.50                  |                  |                |
| Sample 33                           |                 | 0.84              | 15.0             | 0.57             | 6.00                  |                  |                |
| Mean                                |                 | 0.76              | 15.5             | 0.48             | 6.25                  |                  |                |
| Plants                              |                 |                   |                  |                  |                       |                  |                |
| Messerschmidia<br>argentea          | 15.86           | 5.83              | 25.2             |                  | 0.036                 |                  |                |
| Scaevola<br>frutescens              | 12.45           | 1.42              | 2.27             |                  | 0.072                 |                  |                |
| <u>Guettarda</u><br><u>speciosa</u> | 12.48           | 109.10            | 152.7            |                  |                       |                  |                |
| Pandanus<br>tectorius (fruit)       | 14.38           | 923.00            | 206.30           |                  |                       |                  | 0.86           |
| Pandanus<br>tectorius (leaves)      | 6.70            | 679.30            | 391.0            |                  |                       | 0.44             |                |

| Table 77.  | Distribution of radionuclides in terrestrial biota and soil on | BELLE, |
|------------|----------------------------------------------------------------|--------|
| l'abre the | Enewetak Atoll, 1972-1973.                                     |        |

|                                      | Activity, pCi/g, dry wt |                   |                  |                  |                       |                  |  |  |
|--------------------------------------|-------------------------|-------------------|------------------|------------------|-----------------------|------------------|--|--|
| Ecosystem level -                    | <sup>40</sup> K         | <sup>137</sup> Cs | <sup>90</sup> Sr | <sup>60</sup> Co | 239,240 <sub>Pu</sub> | <sup>55</sup> Fe |  |  |
| <u>Soil</u> – Island range           |                         | 5.6-110           | 13-310           | 0.91-20          | 3.5-88                |                  |  |  |
| Mean                                 |                         | 26                | 65               | 6.4              | 22                    |                  |  |  |
| Soil survey<br>Sample 7              |                         | 48.0              | 95.0             | 11.0             | 33.0                  |                  |  |  |
| Sample 9                             | ~                       | 110.0             | 173.0            | 20.0             | 55.0                  |                  |  |  |
| Biota soil sample                    |                         | 5.7               | 61.7             | 6.8              |                       |                  |  |  |
| Plants                               |                         |                   |                  |                  |                       |                  |  |  |
| Messerschmidia<br>argentea           | 13.33                   | 149.10            | 127.50           |                  |                       |                  |  |  |
| <u>Scaevola</u><br><u>frutescens</u> | 12.37                   | 51.00             | 51.8             |                  | 0.048                 | 3.37             |  |  |

Table 78. Distribution of radionuclides in terrestrial biota and soil on CLARA, Enewetak Atoll, 1972-1973.

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|                |                     |                 |                   | Activity         | <u>, pCi/g</u>   | dry wt                |                |                   |
|----------------|---------------------|-----------------|-------------------|------------------|------------------|-----------------------|----------------|-------------------|
| Ecosy          | stem level          | 40 <sub>K</sub> | <sup>137</sup> Cs | 90 <sub>Sr</sub> | <sup>60</sup> Co | 239,240 <sub>Pu</sub> | <sup>3</sup> H | <sup>238</sup> Pu |
| Soil -         | Dense               |                 |                   |                  |                  |                       |                |                   |
|                | Island range        |                 | 3.4-33            | 100-380          | 6.4-26           | 22-98                 |                |                   |
|                | Mean                |                 | 11                | 190              | 11               | 41                    |                |                   |
|                | Sparse              |                 |                   |                  |                  |                       |                |                   |
|                | Island range        |                 | 0.86-9.0          | 16-120           | 0.37-7.4         | 4 3.8 <b>-</b> 33     |                |                   |
|                | Mean                |                 | 3.8               | 32               | 0.85             | 15                    |                |                   |
| Soil su<br>Sam | urvey<br>nple 13    | ~               | 4,50              | 28.0             | 1.20             | 20.0                  |                |                   |
| Sam            | nple 14             |                 | 7.70              | 45.0             | 0.99             | 26.0                  |                |                   |
| Sam            | ple 19              |                 | 7.50              | 120.0            | 1.30             | 33.0                  |                |                   |
| Mea            | an                  |                 | 6.60              | 62.00            | 1.20             | 26.0                  |                |                   |
| Biota          | soil sample         |                 | 65.86             | 554.1            | 21.34            | 148.00                |                |                   |
| Plants         | 5                   |                 |                   |                  |                  |                       |                |                   |
| Messe          | erschmidia<br>entea | 11.10           | 5,90              | 12.21            | 1.45             | 0.055                 |                |                   |
| Scaev<br>frut  | ola<br>escens       | 20.26           | 38.80             | 50.90            | 0.48             | 0.046                 |                | 0.0085            |
| Cocos          | nucifera            |                 |                   |                  |                  |                       |                |                   |
| Mea            | at                  | 6.65            | 7.17              | 0.20             |                  |                       | 0.41           |                   |
| Mill           | k                   | 45.50           |                   | 1.40             |                  |                       |                |                   |
|                |                     |                 |                   |                  |                  |                       |                |                   |

Table 79. Distribution of radionuclides in terrestrial biota and soil on DAISY, Enewetak Atoll, 1972-1973.

|                               |                 |                   | 10               | nCi              |                  |                      |                     |
|-------------------------------|-----------------|-------------------|------------------|------------------|------------------|----------------------|---------------------|
| Sector C                      |                 |                   |                  | uvity, per       | <u>, g, arv</u>  | wt                   |                     |
| Ecosystem level               | 40 <sub>K</sub> | <sup>137</sup> Cs | <sup>60</sup> Co | <sup>90</sup> Sr | <sup>55</sup> Fe | 239,240 <sub>F</sub> | u Other             |
| Soil                          |                 |                   | -                |                  |                  |                      |                     |
| No. 12                        |                 | 0.43              | 0.43             | 9.10             |                  | 3.700                |                     |
| No. 13                        |                 | 0.55              | 0.12             | 9.50             |                  | 2.800                |                     |
| No. 32                        |                 | 3.60              | 0.81             | 29.00            |                  | 3,500                |                     |
| Mean soil data                |                 | 1.50              | 0.45             | 16.00            |                  | 3.300                |                     |
| Biota-C soil                  |                 | 0.47              |                  | 10.27            |                  | 3.020                |                     |
| Plants                        |                 |                   |                  |                  |                  |                      |                     |
| Messerschmidia<br>argentea    | 18.16           | 2.20              | 0.14             |                  |                  | 0.0045               |                     |
| Scaevola                      | 14 0.0          | 1 07              |                  | 1 14             |                  | 0 001                |                     |
| Irutescens                    | 14.08           | 1.67              |                  | 1.14             |                  | 0.031                |                     |
| <u>Lepturus</u> <u>repens</u> | 1.95            | 2.51              | 0.25             | 1.15             |                  | 0.0112               |                     |
| <u>Locos nucliera</u>         | 00.00           | <b>5</b> 11       |                  |                  | <b>00</b> 40     |                      |                     |
| MIIK                          | 99.90           | 5.11              |                  | 1.61             | 86.49            |                      |                     |
| Sector D                      |                 |                   |                  |                  |                  |                      |                     |
| Soil                          |                 |                   |                  |                  |                  |                      |                     |
| No. 48                        |                 | 8.20              | 21.00            | 50.00            |                  | 29.000               |                     |
| Plants                        |                 |                   |                  |                  |                  |                      |                     |
| Cocos nucifera                |                 |                   |                  |                  |                  |                      |                     |
| Meat                          | 7.05            | 1.77              |                  | 0.07             |                  | 0.036                |                     |
| Animals                       |                 |                   |                  |                  |                  |                      |                     |
| <u>Coenobita</u> perlatus (   | hermit c        | rabs)             |                  |                  |                  |                      |                     |
| Hepatopancreas                | 7.04            | 124.30            | 82.80            | 29.60            | 12.80            | 0.196                | <sup>3</sup> H 0.58 |
| Muscle                        | 7.36            | 130.70            | 62.40            | 22.6             | 3.32             | 0.069                | <sup>3</sup> H 0.89 |
| Exoskeleton                   | 1.94            | 27.20             | 1.66             | 491.00           | 0.32             | 0.017                |                     |
| Sector E                      |                 |                   |                  |                  |                  |                      | <u> </u>            |
| Soil                          |                 |                   |                  |                  |                  |                      |                     |
| No. 25                        |                 | 3.50              | 7.40             | 100,00           |                  | 7,700                |                     |
| No. 51                        |                 | 19.00             | 11.00            | 59,00            |                  | 12,000               |                     |
| No. 62                        |                 | 41.00             | 14.00            | 25.00            |                  | 11.000               |                     |
| No. 63                        |                 | 3.00              | 8.90             | 25,00            |                  | 9,200                |                     |
| Average soil data             |                 | 16.6              | 10.30            | 52.00            |                  | 10.000               |                     |
| -                             |                 |                   |                  |                  |                  |                      |                     |

Table 81 (Continued).

Table 81 (Continued).

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|                                                   |                 | £                 | Activity,        | pCi/g, dr        | <u>y_wt</u>      |                       |       |
|---------------------------------------------------|-----------------|-------------------|------------------|------------------|------------------|-----------------------|-------|
| Sector E<br>Ecosystem level                       | 40 <sub>K</sub> | <sup>137</sup> Cs | <sup>60</sup> Co | 90 <sub>Sr</sub> | <sup>55</sup> Fe | 239,240 <sub>Pu</sub> | Other |
| Plants                                            |                 |                   |                  |                  |                  |                       |       |
| Messerschmidia<br>argentea <sup>a</sup>           | 12.74           | 407.30            | 3.39             | 159.00           |                  | 0.0019                |       |
| Messerschmidia<br>argentea (wood)                 | 1.94            | 13.02             | 1.59             | 16.98            |                  | 0.0062                |       |
| <u>Scaevola</u><br><u>frutescens</u> <sup>a</sup> | 10.41           | 205,20            | 21.14            | 57.21            | <b>-</b>         | 0.0029                |       |
| Scaevola<br><u>frutescens</u> (wood)              | 1.82            | 2.22              | 0.91             | 4.60             |                  | 0.0029                |       |
| <u>Guettarda</u><br>speciosa                      | 8.14            | 27.33             | 9.18             | 53.60            |                  |                       |       |

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<sup>a</sup>Integrated samples, 20-25 trees sampled.

| Sector | Site description                                                                                                                  |
|--------|-----------------------------------------------------------------------------------------------------------------------------------|
| A      | South end of island in <u>Scaevola-Messerschmidia</u> regrowth.                                                                   |
| В      | On south side of the east end of the airstrip, in scattered <u>Messerschmidia</u> -ground cover species.                          |
| С      | Mid-island on seaward side, near small clump of young coconut palms, dense <u>Scaevola-Messerschmidia</u> scrub.                  |
| D      | On south side of the west end of the airstrip, open scrub growth.                                                                 |
| E      | In middle of airstrip, on south side, open meadow-like area with scattered Messerschmidia.                                        |
| F      | Near hot spot on island, north of airstrip, 300 yd from shore-<br>line in open <u>Messerschmidia</u> scrub.                       |
| G      | In center of island, near large blockhouse complex, dense regrowth of Messerschmidia-Scaevola.                                    |
| Н      | Western tip of island, at west end of airstrip near small block-<br>house, scattered regrowth of <u>Messerschmidia-Scaevola</u> . |
| I      | Near docking area, mid-island on the lagoon side, dense re-<br>growth of <u>Scaevola-Messerschmidia</u> .                         |

Table 82. Location of biota samples collected on JANET (Engebi), Enewetak Atoll, 1972-1973.

|                                      |                 |                   | 1 otivrit:       | v pCi/a          | day wit               |                  |                     |
|--------------------------------------|-----------------|-------------------|------------------|------------------|-----------------------|------------------|---------------------|
| Gentor A                             |                 |                   | ACTIVIT          | <u>y, pci/g</u>  | , ur v wi             |                  |                     |
| Foosystem level                      | 40 <sub>K</sub> | <sup>137</sup> Cs | <sup>30</sup> Со | <sup>90</sup> Sr | 239,240 <sub>Pu</sub> | <sup>55</sup> Fe | Other               |
| Soil                                 |                 |                   |                  |                  |                       |                  |                     |
| No. 121                              |                 | 0,60              | 0.10             | 6.30             | 0.99                  |                  |                     |
| No. 127                              |                 | 26.00             | 1.00             | 16.00            | 4.10                  |                  |                     |
| Average                              |                 | 13.30             | 0.55             | 11.20            | 2.50                  |                  |                     |
| Diants                               |                 |                   |                  |                  |                       |                  |                     |
| Masserschmidia                       |                 |                   |                  |                  |                       |                  |                     |
| argentea                             | 9.95            | 124.80            |                  | 43.51            | 0.0055                |                  | 2.2.2               |
| Scaevola                             | 10 00           | 54 05             | 0.00             |                  | 0.0000                |                  | 238Pu<br>0.0068     |
| frutescens                           | 12,96           | 54.95             | 0.02             | 32.00            | 0.0068                |                  | $\frac{152}{5}$ Eu  |
| Sector B                             |                 | <u></u>           |                  |                  |                       |                  | 0.20                |
|                                      |                 |                   |                  |                  |                       |                  |                     |
| Soil                                 |                 | 20.00             | 2 5 2            | 50.00            | - 100                 |                  |                     |
| No. 21                               |                 | 29.00             | 2.50             | 52.00            | 7.100                 |                  |                     |
| Plants                               |                 |                   |                  |                  |                       |                  |                     |
| <b>Messers</b> chmidia               | 10.00           | 00                | 0.05             | 40.00            | 0.0100                |                  |                     |
| argentea                             | 18.32           | 555.90            | 0.25             | 40.36            | 0.0103                |                  |                     |
| <u>Scaevola</u><br><u>frutescens</u> | 16.73           | 294.60            |                  | 31.53            | 0.0103                |                  |                     |
| Pandanus                             |                 |                   |                  |                  |                       |                  | <sup>207</sup> Bi   |
| tectorius (leaves)                   | 8.12            | 0.62              |                  | 4.41             |                       |                  | 0.11                |
| Sector C                             |                 | <u> </u>          |                  |                  |                       |                  |                     |
| Soil                                 |                 |                   |                  |                  |                       |                  |                     |
| Soil survey                          |                 |                   |                  |                  |                       |                  |                     |
| No. 63                               |                 | 10.00             | 1.40             | 27.0             | 3.70                  |                  |                     |
| No. 65                               |                 | 11.00             | 0.93             | 20.0             | 2.20                  |                  |                     |
| No. 71                               |                 | 36.00             | 2.90             | 71.0             | 14.00                 |                  |                     |
| Mean                                 |                 | 19.00             | 1.74             | 39.3             | 6.63                  |                  |                     |
| Plants                               |                 |                   |                  |                  |                       |                  |                     |
| Messerschmidia                       |                 |                   |                  |                  |                       |                  |                     |
| argentea                             | 10.50           | 385.80            |                  | 44.60            | 0.0034                |                  |                     |
| <u>Scaevola</u><br><u>frutescens</u> | 18.28           | 134.10            |                  | 16.71            | 0.0049                |                  |                     |
| <u>Cocos</u> nucifera                |                 |                   |                  |                  |                       |                  | 2                   |
| Meat<br>Milk                         | 8.04<br>60.05   | 84.68<br>210.70   |                  | 0.21<br>1.57     |                       |                  | <sup>3</sup> H 0.34 |

Table 83. Distribution of radionuclides in terrestrial biota and soil on JANET (Engebi), Enewetak Atoll, 1872-1973.

Table 83 (Continued).

|                               |             | <u> </u>    | Activ | ity. pCi/g | g. dry wi |        |       |
|-------------------------------|-------------|-------------|-------|------------|-----------|--------|-------|
| Sector D                      | 10          | 137         | 60    | 90         | 229 240   | 55     |       |
| Ecosystem level               | <u>40</u> K | Cs          | Co    | Sr         | Pu        | Fe     | Other |
| Soil                          |             |             |       |            |           |        |       |
| Soil survey No. 131           |             | 42.00       | 4.52  | 95.00      | 2.50      |        |       |
| Plants                        |             |             |       |            |           |        |       |
| Messerschmidia                | 15 20       | 150 20      |       | 191 90     | 0 0000    |        |       |
| <u>argentea</u>               | 10.00       | 1553 00     | 1 26  | 121,20     | 0.0029    |        |       |
| Pluchea odorata               | 10.00       | 1555.00     | 1.20  | 40.05      |           |        |       |
| Sector E                      |             | <del></del> |       |            |           |        |       |
| Soil                          |             |             |       |            |           |        |       |
| Soil survey                   |             |             |       |            |           |        |       |
| No. 58                        |             | 78.00       | 1.50  | 140.00     | 23.00     |        |       |
| No. 61                        |             | 47.00       | 2.30  | 45.00      | 8.90      |        |       |
| No. 62                        |             | 56.00       | 1.20  | 120.00     | 28.00     |        |       |
| Mean                          |             | 60.00       | 1.60  | 101.60     | 19.90     |        |       |
| Plants                        |             |             |       |            |           |        |       |
| Messerschmidia                |             |             |       |            |           |        |       |
| argentea                      | 12.17       | 298.70      |       | 83.80      | 0.005     |        |       |
| <u>Scaevola</u><br>frutescens | 13.65       | 223,40      | 0.45  | 35.70      | 0,003     |        |       |
|                               |             |             |       |            |           |        |       |
| Sector F                      |             |             |       |            |           |        |       |
| Soil                          |             |             |       |            |           |        |       |
| Soil survey No. 12            |             | 25.00       | 9.30  | 120.00     | 23.00     |        |       |
| <u>Plants</u>                 |             |             |       |            |           |        |       |
| Messerschmidia                | 10 40       | 500 10      |       | 100 00     |           |        |       |
| argentea                      | 10.43       | 526.10      | 0.94  | 100.90     |           |        |       |
| Scaevola Irutescens           | 20.57       | 405.90      | 0.24  | 83.30      | 0.0043    |        |       |
| Animals                       |             |             |       |            |           |        |       |
| Rattus rattus (roof 1         | rat)        |             |       |            |           |        |       |
| Viscera                       | 16.23       | 955.00      | 4.96  | 55.90      | 0.730     | 24.30  |       |
| Kidney                        |             | 822.00      | 5.78  |            |           |        |       |
| Liver                         | 33.00       | 742.00      | 2.56  | 0.01       |           | 105.40 |       |
| Lung                          |             | 1069.00     |       | 2.93       |           |        |       |

Table 83 (Continued).

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| <u> </u>        | Activity, pCi/g, dry wt                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                        |                                                       |                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                   |  |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|-------------------------------------------------------|--------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
|                 |                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                        |                                                       | _                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                   |  |
| 40 <sub>K</sub> | <sup>137</sup> Cs                                                                                                                                                                        | <sup>60</sup> Co                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 90 <sub>Sr</sub>                                       | Pu                                                    | <sup>55</sup> Fe                                       | Other                                                                                                                                                                                                                                                                                                                                                                                                             |  |
|                 |                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                        |                                                       |                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                   |  |
| rat)            |                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                        |                                                       |                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                   |  |
|                 | 887.00                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 3.13                                                   | 0.013                                                 | 26.20                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                   |  |
| 10.32           | 546.00                                                                                                                                                                                   | 0.45                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 324.30                                                 | 0.168                                                 |                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                   |  |
|                 | 353.00                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                        |                                                       |                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                   |  |
|                 |                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                        | <u> </u>                                              |                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                   |  |
|                 |                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                        |                                                       |                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                   |  |
|                 |                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                        |                                                       |                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                   |  |
|                 | 52.00                                                                                                                                                                                    | 6.70                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 180.00                                                 | 52.00                                                 |                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                   |  |
|                 | 36.00                                                                                                                                                                                    | 1.30                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 42.00                                                  | 7.10                                                  |                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                   |  |
|                 | 34.00                                                                                                                                                                                    | 3.50                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 88.00                                                  | 20.00                                                 |                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                   |  |
|                 | 53.00                                                                                                                                                                                    | 2.00                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 58.00                                                  | 6.10                                                  |                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                   |  |
|                 | 43.80                                                                                                                                                                                    | 3.37                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 92.00                                                  | 21.30                                                 |                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                   |  |
|                 |                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                        |                                                       |                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                   |  |
|                 |                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                        |                                                       |                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                   |  |
| 14.25           | 299.40                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 48.20                                                  |                                                       |                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                   |  |
| 18.12           | 258.60                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 37.25                                                  |                                                       |                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                   |  |
|                 |                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                        |                                                       |                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                   |  |
| rat)            |                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                        |                                                       |                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                   |  |
| 12.63           | 881.00                                                                                                                                                                                   | 2.35                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 14.14                                                  | 0.460                                                 |                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                   |  |
| 11.38           | 768.00                                                                                                                                                                                   | 1.97                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 6.85                                                   | 0.362                                                 |                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                   |  |
| 26.14           | 656.00                                                                                                                                                                                   | 2.60                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                        |                                                       |                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                   |  |
|                 | 467.00                                                                                                                                                                                   | 4.94                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                        |                                                       |                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                   |  |
| 13.42           | 633.00                                                                                                                                                                                   | 3.23                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | .004                                                   |                                                       | 77.93                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                   |  |
| 18.17           | 604.00                                                                                                                                                                                   | 3.97                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                        |                                                       | 30.86                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                   |  |
| 8.74            | 764.00                                                                                                                                                                                   | 0.29                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 1.28                                                   |                                                       | 30.86                                                  | <sup>3</sup> H6.70                                                                                                                                                                                                                                                                                                                                                                                                |  |
|                 | 697.00                                                                                                                                                                                   | 0.41                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 3.44                                                   | 0.007                                                 | 8.69                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                   |  |
| 21.54           | 587.00                                                                                                                                                                                   | 0.45                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                        | 0.509                                                 |                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                   |  |
| 76.60           | 1272.00                                                                                                                                                                                  | 4.11                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                        |                                                       | 98.7                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                   |  |
|                 | 40 <sub>K</sub><br>rat)<br>10.32<br><br>10.32<br><br>14.25<br>18.12<br>rat)<br>12.63<br>11.38<br>26.14<br><br>13.42<br>18.17<br>8.74<br><br>13.42<br>18.17<br>8.74<br><br>21.54<br>76.60 | $\begin{array}{c ccccc} 40_{\rm K} & 137_{\rm Cs} \\ \hline & 10.32 & 546.00 \\ \hline & 10.32 & 546.00 \\ \hline & 10.32 & 546.00 \\ \hline & 353.00 \\ \hline & & 353.00 \\ \hline & & 36.00 \\ \hline & & 36.00 \\ \hline & & 53.00 \\ \hline & & 697.00 \\ \hline & 21.54 & 587.00 \\ \hline & 76.60 & 1272.00 \\ \hline \end{array}$ | $\begin{array}{c c c c c c c c c c c c c c c c c c c $ | $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ | $\begin{array}{c c c c c c c c c c c c c c c c c c c $ | Activity, pCi/g, dry wt $40_{\rm K}$ $137_{\rm CS}$ $60_{\rm CO}$ $90_{\rm Sr}$ $239, 240_{\rm Pu}$ $55_{\rm Fe}$ rat) $3.13$ $0.013$ $26.20$ $10.32$ $546.00$ $0.45$ $324.30$ $0.168$ $353.00$ $353.00$ $36.00$ $1.30$ $42.00$ $7.10$ $34.00$ $3.50$ $88.00$ $20.00$ $$ $53.00$ $2.00$ $58.00$ $6.10$ $43.80$ $3.37$ $92.00$ $21.30$ 14.25 $299.40$ $48.20$ 13.12 $258.60$ 14.25 $299.40$ $48.20$ 14.25 $299.40$ |  |

<sup>a</sup>Collections made by Enewetak Marine Biological Laboratory personnel in February b<sup>1973.</sup> Collections made by AEC Enewetak Terrestrial Biota Survey in January 1973.

|                       |                 |        | Act              | ivity, pC        | i/g, dry wt           |                  |       |
|-----------------------|-----------------|--------|------------------|------------------|-----------------------|------------------|-------|
| Sector G              |                 |        |                  |                  |                       |                  |       |
| Ecosystem level       | <sup>40</sup> K | Cs     | 60 <sub>Co</sub> | 90 <sub>Sr</sub> | 239,240 <sub>Pu</sub> | <sup>55</sup> Fe | Other |
| Animals               |                 |        |                  |                  |                       |                  |       |
| Rattus rattus (roof r | at)             |        |                  |                  |                       |                  |       |
| Bone <sup>a</sup>     | 8.69            | 661.00 | 0.30             | 115.80           | 0.26                  |                  |       |
| Bone <sup>b</sup>     | 5.97            | 358,00 |                  | 133.80           | 0.167                 |                  |       |
| Skin <sup>a</sup>     | 4,94            | 406.00 |                  |                  |                       |                  |       |
| Skin <sup>b</sup>     | 6.05            | 390.00 |                  |                  |                       |                  |       |
| Sector H              |                 |        |                  |                  |                       |                  |       |
| Soil                  |                 |        |                  |                  |                       |                  |       |
| Soil survey           |                 |        |                  |                  |                       |                  |       |
| No. 113               |                 | 1.10   | 0.56             | 9,70             | 6.30                  |                  |       |
| No. 122               |                 | 1.40   | 0.63             | 13.00            | 6.50                  |                  |       |
| No. 123               |                 | 2.30   | 1.10             | 13.00            | 4.00                  |                  |       |
| No. 143               |                 | 5,90   | 1.80             | 31.00            | 11.00                 |                  |       |
| Mean                  |                 | 2,69   | 1.27             | 16.67            | 6.95                  |                  |       |
| Plants                |                 |        |                  |                  |                       |                  |       |
| Messerschmidia        |                 |        |                  |                  |                       |                  |       |
| argentea              | 13,29           | 322,70 |                  | 45.95            |                       |                  |       |
| Scaevola frutescens   | 14,31           | 63.30  |                  | 17.34            |                       |                  |       |
| Animals               |                 |        |                  |                  |                       |                  |       |
| Rattus rattus (roof r | at)             |        |                  |                  |                       |                  |       |
| Viscera               |                 | 273.20 | 1.72             | 17.30            | 1.40                  |                  |       |
| Kidney                |                 | 275.00 | 2.63             |                  |                       |                  |       |
| Liver                 |                 | 211.50 | 2.21             | 0.01             | 0.0016                | 24.40            |       |
| Lung                  | 48.30           | 308.00 |                  | 0.55             | 1.320                 |                  |       |
| Muscle                |                 | 286.50 | 0.23             | 2.29             | 0.0097                | 10.54            |       |
| Bone                  | 9.06            | 129.00 | 0.22             | 68.90            | 0.0302                |                  |       |
| Skin                  | 7.81            | 181.00 |                  |                  |                       | ****             |       |

Table 83 (Continued).

<sup>a</sup>Collections made by Enewetak Marine Biological Laboratory personnel in February <sup>1973.</sup> <sup>b</sup>Collections made by AEC Enewetak Terrestrial Biota Survey in January 1973.

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| Table 83 | (Continued) |
|----------|-------------|
|----------|-------------|

|                       |          |        | Activi | ty. pCi/g | dry wt   |          |                            |
|-----------------------|----------|--------|--------|-----------|----------|----------|----------------------------|
| Sector H              | 40       | 137 -  | 60 -   | 90-       | 239.240- | 55.      |                            |
| Ecosystem level       | <u> </u> | Cs     | Co     | Sr        | Pu       | <u> </u> | Other                      |
| Birds                 |          |        |        |           |          |          |                            |
| Anous stolidus        |          |        |        |           |          |          |                            |
| (Common noddy)        |          |        |        |           |          |          |                            |
| Viscera               | 9.62     |        |        |           |          | 52.25    |                            |
| Liver                 |          | 171.60 |        | 0.005     | 0.0015   |          |                            |
| Muscle                | 9.19     |        | 0.51   | 0.008     | 0.002    | 104.50   |                            |
| Eggshell              |          |        |        | 16.04     |          | 1.28     |                            |
| Egg                   | 6.21     |        |        | 0.20      | 0.0148   | 57.21    |                            |
| Bone                  | 3.04     | 0.73   |        | 0.39      |          | 50.0     |                            |
| Sector I              |          |        |        |           |          |          |                            |
| Soil                  |          |        |        |           |          |          |                            |
| Soil survey           |          |        |        |           |          |          |                            |
| No. 118               |          | 6.50   | 0.43   | 18.00     | 3.50     |          |                            |
| No. 125               |          | 9.70   | 0.19   | 25.00     | 2.10     |          |                            |
| Mean                  |          | 8.10   | 0.31   | 22.00     | 2.80     |          |                            |
| Plants                |          |        |        |           |          |          |                            |
| Messerschmidia        | 10 70    |        |        | 10.00     | 0.0150   |          |                            |
| argentea              | 12.72    | 36.43  |        | 18.38     | 0.0152   |          |                            |
| Scaevola frutescens   | 17.44    | 30.50  |        | 12.16     | 0.0163   |          |                            |
| Animals               |          |        |        |           |          |          |                            |
| Rattus rattus (roof r | rat)     |        |        |           |          |          |                            |
| Viscera               | 18.54    | 999.50 | 2.93   | 8.74      | 0.416    |          |                            |
| Kidney                | 62.34    | 838.30 | 5.99   |           |          |          |                            |
| Liver                 |          | 897.70 | 6.32   | 0.01      | 0.018    | 86.94    | <sup>151</sup> Sm<br>34.30 |
| Muscle                | 13.87    | 765.80 | 0.64   | 3.14      | 0.023    | 16.31    |                            |
| Bone                  |          | 627.50 | 0.51   | 121.20    | 3.248    |          |                            |
| Skin                  | 10.70    | 515.30 | 0.92   |           |          |          |                            |
| Lung                  | 29.70    | 830.00 | 2.17   | 1.80      | 0.865    | <b></b>  |                            |
|                       |          |        |        |           |          |          |                            |

|                                           | Activity, pCi/g, dry wt |                   |                  |                  |                       |                          |  |
|-------------------------------------------|-------------------------|-------------------|------------------|------------------|-----------------------|--------------------------|--|
| Ecosystem level                           | 40 <sub>K</sub>         | <sup>137</sup> Cs | 90 <sub>Sr</sub> | <sup>60</sup> Co | <sup>239,240</sup> Pu | Other                    |  |
| <u>Soil</u> - Dense                       |                         |                   |                  |                  |                       |                          |  |
| Island range                              |                         | 0.08-37           | 1.6-200          | 0.03-5.8         | 0.17-50               |                          |  |
| Mean                                      |                         | 13.1              | 43.5             | 1.90             | 11.02                 |                          |  |
| Soil - Sparse                             |                         |                   |                  |                  |                       |                          |  |
| Island range                              |                         | 1.8-16            | 1.6-49           | 0.03-3.5         | 0.17-14               |                          |  |
| Mean                                      |                         | 4.8               | 11               | 0.46             | 2.3                   |                          |  |
| Soil survey No. 17                        |                         | 3,90              | 45.0             | 2.3              | 14.0                  |                          |  |
| Biota soil sample                         |                         | 4.30              | 47.0             | 1.1              | 11.0                  |                          |  |
| Mean                                      |                         | 4.10              | 46.0             | 1.7              | 12.5                  |                          |  |
| Plants                                    |                         |                   |                  |                  |                       |                          |  |
| Messerschmidia<br>argentea                | 9.62                    | 4.26              | 3.75             |                  | 0.005                 |                          |  |
| frutescens                                | 14.60                   | 16.36             |                  |                  |                       |                          |  |
| Pisonia<br>grandis                        | 9.59                    | 221.10            | 23.60            | 3.85             | 0.0045                |                          |  |
| citrifolia                                | 14.50                   | 34.09             | 23.56            |                  | 0.001                 |                          |  |
| Animals                                   |                         |                   |                  |                  |                       |                          |  |
| Phaethon rubricaudu<br>(red-tailed tropic | is<br>Dird)             |                   |                  |                  |                       |                          |  |
| Viscera                                   | 7.81                    |                   |                  |                  |                       |                          |  |
| Muscle                                    | 8.79                    |                   |                  |                  |                       |                          |  |
| Bone                                      |                         | 0.10              |                  |                  |                       | <sup>65</sup> Zn<br>0.64 |  |

Table 84. Distribution of radionuclides in terrestrial biota and soil on KATE, Enewetak Atoll, 1972-1973. I

|                                                | Activity, pCi/g, dry wt |                   |                  |                  |                       |                  |                           |  |
|------------------------------------------------|-------------------------|-------------------|------------------|------------------|-----------------------|------------------|---------------------------|--|
| Ecosystem level                                | 40 <sub>K</sub>         | <sup>137</sup> Cs | <sup>90</sup> Sr | 60 <sub>Co</sub> | 239,240 <sub>Pu</sub> | <sup>55</sup> Fe | Other                     |  |
| Coil                                           |                         |                   |                  |                  |                       |                  |                           |  |
| Island range                                   |                         | 2.2 <b>-</b> 25   | 10-83            | 0.26-3.8         | 2.4-22                |                  |                           |  |
| Mean                                           |                         | 11                | 32               | 1.5              | 7.7                   |                  |                           |  |
| Soil survey                                    |                         |                   |                  |                  |                       |                  |                           |  |
| No. 16                                         |                         | 0.10              | 4.40             | 0.05             | 2.10                  |                  |                           |  |
| No. 18                                         |                         | 0.12              | 4.40             | 0.05             | 1.50                  |                  |                           |  |
| Biota soil sample                              |                         | 2.24              | 22.40            | 0.90             | 4.90                  |                  |                           |  |
| Plants                                         |                         |                   |                  |                  |                       |                  |                           |  |
| Messerschmidia<br>argentea                     | 10.73                   | 6.36              |                  |                  |                       |                  | <sup>155</sup> Eu<br>0.05 |  |
| Scaevola<br>frutescens                         | 13.01                   | 12.73             |                  |                  |                       |                  |                           |  |
| Animals<br>Coenobita perlatus<br>(hermit crab) |                         |                   |                  |                  |                       |                  |                           |  |
| Hepatopancreas/<br>gonad                       | 10.42                   | 125.70            |                  | 2.95             |                       |                  |                           |  |
| Exoskeleton                                    |                         | 39.15             |                  | 0.97             |                       |                  |                           |  |
| Anous stolidus<br>(common noddy)               |                         |                   |                  |                  |                       |                  |                           |  |
| Viscera                                        | 13.08                   |                   |                  |                  |                       | 108.60           |                           |  |
| Liver                                          |                         |                   | 0.19             |                  |                       |                  |                           |  |
| Muscle                                         | 12.23                   |                   |                  |                  | 0.022                 | 8.78             |                           |  |
| Bone                                           |                         | 7.45              | 0.71             |                  |                       | 38.50            |                           |  |

Table 85. Distribution of radionuclides in terrestrial biota and soil on LUCY, Enewetak Atoll, 1972-1973.

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Carden -

|                                                    | Activity, pCi/g, dry wt |                   |                  |                  |                       |                  |
|----------------------------------------------------|-------------------------|-------------------|------------------|------------------|-----------------------|------------------|
| Ecosystem level                                    | 40 <sub>K</sub>         | 137 <sub>Cs</sub> | 90 <sub>Sr</sub> | <sup>60</sup> Co | 239,240 <sub>Pu</sub> | <sup>55</sup> Fe |
| Soil                                               |                         |                   |                  |                  |                       |                  |
| Hot spot                                           |                         |                   |                  |                  |                       |                  |
| Range                                              |                         | 7.4-55            | 35-140           | 3.6-70           | 15-530                |                  |
| Mean                                               |                         | 19                | 62               | 12               | 51                    |                  |
| Remainder                                          |                         |                   |                  |                  |                       |                  |
| Range                                              |                         | 1.2-34            | 3.2-61           | 0.49-49          | 0.85-100              |                  |
| Mean                                               |                         | 7.6               | 17               | 4.1              | 11                    |                  |
| Soil survey                                        |                         |                   |                  |                  |                       |                  |
| No. 41                                             |                         | 12.0              | 33.0             | 2.2              | 12.0                  |                  |
| No. 42                                             |                         | 9.1               | 19.0             | 1.1              | 7.6                   |                  |
| No. 43                                             |                         | 0.24              | 32.0             | 0.05             | 1.1                   |                  |
| No. 44                                             |                         | 1.80              | 5,90             | 1.90             | 2.4                   |                  |
| Mean                                               |                         | 5.78              | 15.30            | 1.30             | 5.8                   |                  |
| Biota soil sample                                  |                         | 7.90              | 17.04            | 1.90             | 6.68                  |                  |
| <u>Plants</u><br><u>Messerschmidia</u><br>argentea | 14.66                   | 0.29              | 0 47             |                  |                       |                  |
| Scaevola                                           |                         |                   |                  |                  |                       |                  |
| frutescens                                         | 16.50                   | 0.34              | 0.35             |                  | 0.0023                |                  |
| Scaevola<br>frutescens <sup>a</sup>                | 12.52                   | 30.82             | <b>20.</b> 99    | 0.16             | 0.0031                |                  |
| Animals                                            |                         |                   |                  |                  |                       |                  |
| Sterna fuscata<br>(sooty tern)                     |                         |                   |                  |                  |                       |                  |
| Liver                                              |                         |                   |                  | 0.65             |                       | 317.00           |
| Rattus exulans<br>(rice rat)                       |                         |                   |                  |                  |                       |                  |
| Liver                                              | 32.33                   | 33.30             | 164.90           | 5.07             | 0.0119                | 82.00            |
| Viscera                                            | 61.49                   | 30.80             | 1.79             | 7.45             | 1.77                  |                  |
| Muscle                                             | 11.60                   | 37.07             | 0.04             | 0.89             | 0.117                 | 23.20            |
| Bone                                               | 9.57                    | 53.60             | 36.10            | 2.59             |                       |                  |
| Skin                                               | 8.40                    | 15.00             |                  | 1.58             |                       |                  |
| Kidney                                             | 51.50                   | 27.90             |                  | 5.40             |                       |                  |
| Lungs                                              |                         | 51.22             | 0.84             |                  | 8.15                  |                  |

Table 86. Distribution of radionuclides in terrestrial biota and soil on PEARL, Enewetak Atoll, 1972-1973.

<sup>a</sup>From an area of higher environmental radioactivity in center of island.

|                              | Activity, pCi/g, dry wt |                   |                  |                  |                       |                  |                            |
|------------------------------|-------------------------|-------------------|------------------|------------------|-----------------------|------------------|----------------------------|
| Ecosystem level              | 40 <sub>K</sub>         | 137 <sub>Cs</sub> | 90 <sub>Sr</sub> | 60 <sub>Co</sub> | 239,240 <sub>Pu</sub> | <sup>55</sup> Fe | Other                      |
|                              |                         |                   |                  |                  |                       |                  |                            |
| Soll                         |                         | 0.13-7.8          | 2.0-19           | 0.05-1.          | 7 0.26-7.3            |                  |                            |
| Island Longo                 |                         | 1 7               | 6 8              | 0.31             | 1 3                   |                  |                            |
| Mean                         |                         |                   | 0.0              |                  |                       |                  |                            |
| Soll Survey                  |                         | 2 90              | 10 00            | 0 74             | 3 00                  |                  |                            |
| No. 14                       |                         | 5 30              | 13 00            | 1 20             | 4 20                  |                  |                            |
| No. 17                       |                         | 1.40              | 0.70             | 1.20             | 9.54                  |                  |                            |
| Biota soil sample            |                         | 1.40              | 9.70             | 0.09             | 0.54                  |                  |                            |
| Mean                         |                         | 3.20              | 11.50            | 0.87             | 3.60                  |                  |                            |
| Plants                       |                         |                   |                  |                  |                       |                  |                            |
| Messerschmidia<br>argentea   | 10.09                   | 104.90            | 13.60            |                  |                       |                  |                            |
| Scaevola<br>frutescens       | 5.45                    | 91.49             | 6.13             |                  |                       |                  |                            |
| Guettarda<br>speciosa        | 14.23                   | 13.27             | 7.30             |                  |                       |                  |                            |
| Animals                      |                         |                   |                  |                  |                       |                  |                            |
| Rattus exulans<br>(rice rat) |                         |                   |                  |                  |                       |                  |                            |
| Viscera                      | 10.87                   | 43.14             | 2,17             | 1.13             |                       |                  |                            |
| Liver                        | 6.72                    | 39.41             |                  | 3.59             | 0.041                 | 42.20            | 207 <sub>Bi</sub><br>0.375 |
| Muscle                       | 9.22                    | 37.86             |                  |                  |                       |                  |                            |
| Bone                         | 7.26                    | 61.58             | 19,60            |                  | 0.146                 |                  |                            |
| Skin                         | 7.58                    | 18.50             |                  | 0.41             |                       |                  |                            |
| Kidnev                       |                         | 38.40             |                  |                  |                       |                  |                            |
| Lungs                        |                         | 45.00             |                  |                  |                       |                  |                            |

| cable 87. | Distribution of r | adionuclides in | terrestrial | biota and | l soil on | URSULA, |
|-----------|-------------------|-----------------|-------------|-----------|-----------|---------|
| 40        | Enewetak Atoll,   | 1972-1973.      |             |           |           |         |

|                             | Activity, pCi/g, dry wt |                   |                  |                  |                       |                  |                     |
|-----------------------------|-------------------------|-------------------|------------------|------------------|-----------------------|------------------|---------------------|
| Ecosystem_level             | 40 <sub>K</sub>         | 137 <sub>Cs</sub> | 90 <sub>Sr</sub> | <sup>60</sup> Co | 239,240 <sub>Pu</sub> | <sup>55</sup> Fe | Other               |
| Soil                        |                         |                   |                  |                  |                       |                  |                     |
| Island range                |                         | 0.03-30           | 0.87-140         | 0.05-69          | 0.21-130              |                  |                     |
| Mean                        |                         | 3.0               | 8.4              | 0.54             | 4.3                   |                  |                     |
| Soil survev                 |                         |                   |                  |                  |                       |                  |                     |
| No. 4                       |                         | 3.20              | 15.0             | 0.81             | 1.90                  |                  |                     |
| No. 7                       |                         | 1.50              | 8.3              | 0.70             | 0.39                  |                  |                     |
| Biota soil sample           |                         | 10.30             | 24.55            | 1.26             | 1.89                  |                  |                     |
| Plants                      |                         |                   |                  |                  |                       |                  |                     |
| Messerschmidia              | 0 00                    | 12 63             | 1 86             | 0 10             | 0 059                 |                  |                     |
| <u>argentea</u>             | 10.20                   | 12.00             | 4.00<br>6.67     | 0.10             | 0.000                 |                  | 238 Pu              |
| Scaevola Trutescens         | 10.70                   | 10.00             | 0.01             |                  | 0.000                 |                  | 0.0027              |
| Pandanus tectorius          | 14.02                   | 14.98             | 1.97             |                  | <b>0</b> .015         | 0.703            |                     |
| Lepturus repens<br>(grass)  | 3.74                    | 83.20             | 1.98             |                  | 0.0227                |                  |                     |
| Animals                     |                         |                   |                  |                  |                       |                  |                     |
| Rattus exulans (rice        | rat)                    |                   |                  |                  |                       |                  |                     |
| Viscera                     | 9.63                    | 92.97             | 14.60            | 1.48             | 1.300                 |                  |                     |
| Liver                       | 10.73                   | 63.83             | 0.002            | 2.54             | 0.008                 | 35.50            |                     |
| Lung                        | 13.20                   | 73.90             | 0.22             | 0.67             | 0.198                 |                  | 2                   |
| Muscle                      | 5.82                    | 60.86             |                  |                  |                       |                  | <sup>3</sup> H 18.7 |
| Bone                        | 7.01                    | 65.77             | 25.90            | 0.81             | 0.039                 |                  |                     |
| Skin                        | 4.52                    | 49.10             |                  | 0.49             |                       |                  |                     |
| Kidney                      |                         | 73.30             |                  | 2.28             |                       |                  |                     |
| <u>Sterna fuscata</u> (soot | y tern)                 |                   |                  |                  |                       |                  |                     |
| Viscera                     | 4.79                    |                   |                  |                  |                       | 22.43            |                     |
| Liver                       |                         |                   |                  |                  |                       | 155.00           |                     |
| Muscle                      | 7.63                    |                   | 0.014            |                  | 0.020                 | 109.50           |                     |
| Egg                         | 4.57                    |                   | 0.004            |                  | 0.015                 | 37.57            |                     |
| Eggshell                    |                         |                   | 0.265            |                  | 0.005                 |                  |                     |
| Bone                        |                         |                   |                  |                  |                       | 35.70            |                     |
| Anous tenuirostris          | (white-                 | capped ter        | n)               |                  |                       |                  |                     |
| Viscera                     | 5.89                    |                   |                  |                  |                       | 64.40            |                     |
| Liver                       |                         |                   |                  |                  | 0.011                 |                  |                     |
| Muscle                      | 6.31                    |                   |                  |                  | 0.005                 | 36.60            |                     |
| Bone                        |                         | 0.14              | 1.68             | 0.34             |                       | 61.3             |                     |

Table 88. Distribution of radionuclides in terrestrial biota and soil on SALLY, Enewetak Atoll, 1972-1973.

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|                            | Activity, pCi/g, dry wt |                   |                  |                  |               |                  |  |  |  |  |
|----------------------------|-------------------------|-------------------|------------------|------------------|---------------|------------------|--|--|--|--|
| Ecosystem level            | 40 <sub>K</sub>         | <sup>137</sup> Cs | <sup>90</sup> Sr | <sup>60</sup> Co | 239,240<br>Pu | 55 <sub>Fe</sub> |  |  |  |  |
| Soil                       |                         |                   |                  |                  |               |                  |  |  |  |  |
| Dense                      |                         |                   |                  |                  |               |                  |  |  |  |  |
| Range                      |                         | 3.5-20            | 17.54            | 0.61-1.9         | 1.4-17        |                  |  |  |  |  |
| Mean                       |                         | 8.4               | 27               | 1.2              | 7.6           |                  |  |  |  |  |
| Sparse                     |                         |                   |                  |                  |               |                  |  |  |  |  |
| Range                      |                         | 0.04-5.3          | 2.2-47           | 0.21-1.7         | 1.1-34        |                  |  |  |  |  |
| Mean                       |                         | 1.0               | 8.7              | 0.37             | 2.5           |                  |  |  |  |  |
| Soil survey No. 4          |                         | 3.20              | 10.14            | 2.58             | 1.11          |                  |  |  |  |  |
| Biota soil sample          |                         | 4.90              | 98.65            | 3.75             | 29.32         |                  |  |  |  |  |
| Plants                     |                         |                   |                  |                  |               |                  |  |  |  |  |
| Messerschmidia<br>argentea | 10.13                   | 58.78             | 10.27            |                  |               |                  |  |  |  |  |
| Scaevola frutescens        | 11.39                   | 24.94             | 9.05             |                  | 0.0042        |                  |  |  |  |  |
| Morinda citrifolia         | 13.94                   | 13.90             | 12.48            |                  |               |                  |  |  |  |  |
| Pandanus tectorius         | 13.29                   | 152.20            | 15.50            |                  | 0.0069        |                  |  |  |  |  |
| Guettarda speciosa         | 10.10                   | 5.90              | 12.57            |                  | 0.0091        |                  |  |  |  |  |

Table 89. Distribution of radionuclides in terrestrial biota and soil on TILDA, Enewetak Atoll, 1972-1973.

Table 90. Distribution of radionuclides in terrestrial biota and soil on VERA, Enewetak Atoll, 1972-1973.

|                            | Activity, pCi/g, dry wt |                   |                  |                  |                       |                  |  |  |  |
|----------------------------|-------------------------|-------------------|------------------|------------------|-----------------------|------------------|--|--|--|
| Ecosystem level            | 40 <sub>K</sub>         | <sup>137</sup> Cs | 90 <sub>Sr</sub> | <sup>60</sup> Co | 239,240 <sub>Pu</sub> | <sup>55</sup> Fe |  |  |  |
| Soil                       |                         |                   |                  |                  |                       |                  |  |  |  |
| Range                      |                         | 0.03-12           | 1.1-68           | .04-2.2          | 0.60-25               |                  |  |  |  |
| Mean                       |                         | 2.0               | 6.3              | 0.56             | 2.5                   |                  |  |  |  |
| Soil survey No. 10         |                         | 2.10              | 1.40             | 0.2              | 0.75                  |                  |  |  |  |
| Biota soil sample          |                         | 2.80              | 8.90             | 0.3              | 2.98                  |                  |  |  |  |
| <u>Plants</u>              |                         |                   |                  |                  |                       |                  |  |  |  |
| Messerschmidia<br>argentea | 7.07                    | 10.77             | 12.79            | ** ** == ==      | 0.0024                |                  |  |  |  |
| Scaevola frutescens        | 8.18                    | 1.69              | 4.49             |                  |                       |                  |  |  |  |
| Morinda citrifolia         | 10.46                   | 12.12             | 11.85            |                  |                       |                  |  |  |  |
| Pandanus tectorius         | 9.17                    | 17.58             | 4.24             |                  | 0.0076                |                  |  |  |  |
| Cocos nucifera             | 5.64                    | 9.30              | 0.13             |                  |                       |                  |  |  |  |
| Pisonia grandis            | 28.58                   | 56.94             | 23.11            |                  |                       |                  |  |  |  |

|                         | Activity, pCi/g, dry wt |                         |                  |                  |                       |  |  |  |  |
|-------------------------|-------------------------|-------------------------|------------------|------------------|-----------------------|--|--|--|--|
| Ecosystem level         | <sup>40</sup> K         | $\frac{137}{\text{Cs}}$ | <sup>90</sup> Sr | <sup>60</sup> Co | 239,240 <sub>Pu</sub> |  |  |  |  |
| Soil                    |                         |                         |                  |                  |                       |  |  |  |  |
| Range                   |                         | 0.31-7.2                | 0.26-13          | 0.01-0.70        | 0.1-5.3               |  |  |  |  |
| Mean                    |                         | 1.3                     | 3.3              | 0.12             | 1.1                   |  |  |  |  |
| Soil survey             |                         |                         |                  |                  |                       |  |  |  |  |
| No. 21                  |                         | 1.10                    | 4.2              | 0.18             | 1.30                  |  |  |  |  |
| No. 22                  |                         | 1.80                    | 2.5              | 0.14             | 0.70                  |  |  |  |  |
| Mean                    |                         | 1.45                    | 3.4              | 0.16             | 1.00                  |  |  |  |  |
| Plants                  |                         |                         |                  |                  |                       |  |  |  |  |
| Messerschmidia argentea | 5.00                    | 6.19                    |                  |                  |                       |  |  |  |  |
| Scaevola frutescens     | 10.31                   | 1.24                    |                  |                  |                       |  |  |  |  |
| Guettarda speciosa      | 10.60                   | 3.14                    |                  |                  |                       |  |  |  |  |

Table 91. Distribution of radionuclides in terrestrial biota and soil on WILMA, Enewetak Atoll, 1972-1973.

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Table 92. Locations of biota samples collected on YVONNE (Runit), Enewetak Atoll, 1972-1973.

| Sector | Description                                                                                  |
|--------|----------------------------------------------------------------------------------------------|
| A      | At north end of island, near Cactus crater in scattered<br>Messerschmidia-Scaevola regrowth. |
| В      | At north end of island, on lagoon side of road, 150 yd south of Cactus crater.               |
| С      | Mid-island, on peninsula which extends into seaward reef, along old airstrip.                |
| D      | Old camp area at south end of island.                                                        |

|                             |                 |                   | Activ            | ity, pCi         | /g, dry wt            |                  |                            |
|-----------------------------|-----------------|-------------------|------------------|------------------|-----------------------|------------------|----------------------------|
| Sector A<br>Ecosystem level | 40 <sub>K</sub> | <sup>137</sup> Cs | 90 <sub>Sr</sub> | <sup>60</sup> Co | 239,240 <sub>Pu</sub> | <sup>55</sup> Fe | Other                      |
| Soil                        |                 |                   |                  |                  |                       |                  |                            |
| Soil survey                 |                 |                   | ,                |                  |                       |                  |                            |
| No. 139                     |                 | 7.30              |                  | 16.00            | 23.00                 |                  |                            |
| No. 140                     |                 | 6.50              | 10.00            | 4.10             | 5.60                  |                  |                            |
| No. 141                     |                 | 47.00             | 190.00           | 54.00            | 55.00                 |                  |                            |
| Mean                        |                 | 20.26             | 100.00           | 24.70            | 27.87                 |                  |                            |
| Plants                      |                 |                   |                  |                  |                       |                  |                            |
| Messerschmidia<br>argentea  | 9 <b>.93</b>    | 5644.00           | 257.20           | 1.16             | 0.253                 |                  |                            |
| Scaevola frutescens         | 18.77           | 658.00            | 80.63            | 6.26             | 0.195                 |                  |                            |
| Scaevola frutescens         | 10.68           | 609.00            | 159.00           | 20.26            | 0.322                 |                  |                            |
| Guettarda speciosa          | 11.15           | 794.00            | 64.41            | 4.52             | 0.002                 |                  |                            |
| Animals                     |                 |                   |                  |                  |                       |                  |                            |
| Rattus rattus (roof r       | ·at)            |                   |                  |                  |                       |                  | _                          |
| Muscle                      | 12.35           | 4240.00           | 5.09             | 12.35            | 0.052                 | 32.80            | <sup>3</sup> H 1.8         |
| Bone                        |                 | 1833.00           | 146.40           | 5.92             | 0.057                 |                  |                            |
| Viscera                     | 7.61            | 2928.00           |                  | 112.60           | 1.05                  |                  |                            |
| Skin                        | 6.69            | 2088.00           |                  | 14.00            |                       |                  | 1 - 1                      |
| Liver                       |                 | 2559.00           |                  | 7.03             | 0.027                 | 126.10           | <sup>151</sup> Sm<br>18.70 |
| Kidney                      |                 | 3427.00           |                  | 257.70           |                       |                  |                            |
| Lung                        | 14.26           | 3306.00           | 0.24             | 10.53            | 0.107                 |                  | <sup>134</sup> Cs 1.5      |
| Muscle                      | 13.07           | 3824.00           | 37.79            | 8.51             | 0.003                 | 78.83            |                            |
| Bone                        | 7.93            | 2199.00           | 135.10           | 10.57            | 0.029                 |                  | <sup>134</sup> Cs 1.36     |
| Viscera                     | 13.33           | 3531.00           | 4.09             | 230.00           | 0.581                 |                  |                            |
| Skin                        | 6.92            | 1875.00           |                  | 7.43             |                       |                  |                            |
| Liver                       | 14.15           | 2215.00           | 0.005            | 86.13            | 0.013                 | 135.60           |                            |
| Kidney                      | 33.10           | 3286.00           |                  | 261.80           |                       | 252.30           |                            |
| Lung                        | 33.12           | 2760.00           | 16.17            | 11.08            |                       |                  |                            |

Table 93. Distribution of radionuclides in terrestrial biota and soil on YVONNE, Enewetak Atoll, 1972-1973.

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Table 93 (Continued).

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|                                   |           |                   | Activity         | y, pCi∕g         | g, dry wt  |                  |                         |
|-----------------------------------|-----------|-------------------|------------------|------------------|------------|------------------|-------------------------|
| Sector B                          | 10        | 105               | 0.0              |                  |            |                  |                         |
| Ecosystem level                   | $^{40}$ K | <sup>137</sup> Cs | 90 <sub>Sr</sub> | <sup>60</sup> Co | 239,240 Pu | <sup>55</sup> Fe | <u>Other</u>            |
| Soil                              |           |                   |                  |                  |            |                  |                         |
| Soil survey                       |           |                   |                  |                  |            |                  |                         |
| No. 135                           | 0.31      | 0.52              | 2.50             | 0.29             | 3.400      |                  |                         |
| No. 136                           |           | 1.70              | 3.50             | 0.84             | 7.000      |                  |                         |
| No. 137                           | 1.60      | 1.60              | 2.50             | 0.28             | 9.400      |                  |                         |
| Biota soil sample                 | 1.26      | 4.33              | 6.13             | 0.69             |            |                  |                         |
| Mean                              |           | 2.04              | 3.65             | 0.52             | 6.60       |                  |                         |
| <u>Plants</u>                     | X         |                   |                  |                  |            |                  |                         |
| Messerschmidia                    |           |                   |                  |                  |            |                  |                         |
| argentea                          | 10.91     | 95.32             | 8.60             |                  | 0.013      |                  |                         |
| <u>Scaevola</u> <u>frutescens</u> | 15.93     | 28.25             | 1.94             |                  | 0.190      |                  | ર                       |
| <u>Cocos nucifera</u>             |           |                   |                  |                  |            |                  | Ч                       |
| Meat                              | 8.24      | 3.96              | 0.01             |                  |            |                  | 0.66                    |
| Animals                           |           |                   |                  |                  |            |                  |                         |
| Rattus rattus (roof r             | at)       |                   |                  |                  |            |                  |                         |
| Muscle                            | 16.82     | 86.04             |                  |                  |            |                  |                         |
| Bone                              | 9.74      | 48.78             | 16.67            |                  | 0.304      |                  |                         |
| Viscera                           | 9.67      | 76.71             | 0.57             | 1.99             | 0.393      |                  |                         |
| Skin                              | 4.74      | 42.64             |                  |                  |            |                  |                         |
| Liver                             |           | 56.22             |                  | 2.90             | 0.008      | 25.01            | <sup>151</sup> Sm 23.00 |
| Kidney                            |           | 59.64             |                  | 4.96             |            |                  |                         |
| Lung                              |           | 39.72             |                  |                  | 0.023      |                  |                         |
| Anous stolidus (com               | mon noc   | ldy)              |                  |                  |            |                  |                         |
| Egg                               | 7.22      |                   | 0.07             |                  |            | 54.50            |                         |
| Eggshell                          |           |                   |                  |                  | 0.009      |                  |                         |
| Viscera                           | 8.34      |                   |                  |                  |            | 64.41            |                         |
| Liver                             |           |                   |                  | 0.37             |            | 385.60           |                         |
| Muscle                            | 7.39      |                   | 0.007            | 0.23             | 0.02       | 22.61            |                         |
| Bone                              |           | 5.51              |                  |                  | 0.021      | 63.50            |                         |

Table 93 (Continued)

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|                            | Activity, pCi/g, dry wt |        |        |       |         |                                                    |  |  |  |
|----------------------------|-------------------------|--------|--------|-------|---------|----------------------------------------------------|--|--|--|
| Sector C                   | 40                      | 137 ~  | 90_    | 60 -  | 239.240 | 55-                                                |  |  |  |
| Ecosystem level            | K                       | Cs     | Sr     | Co    | Pu      | Fe Other                                           |  |  |  |
| Soil                       |                         |        |        |       |         |                                                    |  |  |  |
| Soil survey                |                         |        |        |       |         |                                                    |  |  |  |
| No. 26                     |                         | 3.40   | 3.40   | 2.80  | 6.300   |                                                    |  |  |  |
| No. 28                     |                         | 2.30   | 9.40   | 9.50  | 21.000  |                                                    |  |  |  |
| No. 29                     |                         | 0.55   | 1.50   | 4.60  | 3.300   |                                                    |  |  |  |
| No. 55                     |                         | 2.30   | 4.30   | 2.20  | 5.300   |                                                    |  |  |  |
| Mean                       |                         | 2.13   | 4.65   | 4.70  | 8.970   |                                                    |  |  |  |
| Plants                     |                         |        |        |       |         |                                                    |  |  |  |
| Messerschmidia<br>argentea | 14.19                   | 2.28   | 0.064  |       | 0.008   |                                                    |  |  |  |
| Messerschmidia<br>argentea | 14.46                   | 3.81   | 1.43   |       | 0.011   |                                                    |  |  |  |
| Messerschmidia<br>argentea | 10.91                   | 95.32  | 8.60   |       | 0.129   |                                                    |  |  |  |
| <u>Scaevola</u> frutescens | 13.21                   | 11.88  | 1.76   | 0.51  | 0.026   | <sup>238</sup> Pu 0.0068                           |  |  |  |
| Scaevola frutescens        | 14.16                   | 1.57   | 0.44   |       | 0.004   |                                                    |  |  |  |
| <u>Scaevola</u> frutescens | 15.00                   | 8.06   | 0.66   | 0.25  | 1.293   | <sup>238</sup> Pu 0.061<br><sup>241</sup> Am 0.146 |  |  |  |
| Scaevola frutescens        | 10.68                   | 609.90 | 159.00 | 20.26 | 0.322   |                                                    |  |  |  |
| Scaevola frutescens        | 15.93                   | 28.25  | 1.94   |       | 0.190   | <sup>238</sup> Pu 0.076                            |  |  |  |
| Animals                    |                         |        |        |       |         |                                                    |  |  |  |
| Rattus rattus (roof r      | ·at)                    |        |        |       |         |                                                    |  |  |  |
| Skin                       |                         | 28.40  |        | 0.69  |         |                                                    |  |  |  |
| Lung                       |                         | 53.33  |        |       | 0.568   |                                                    |  |  |  |
| Viscera                    |                         | 55.81  |        |       | 0.211   | 3.46 <sup>238</sup> Pu 0.096                       |  |  |  |
| Liver                      |                         | 38.68  | 0.002  | 5.63  | 0.011   | 13.83                                              |  |  |  |
| Kidney                     | 30.64                   | 29.00  |        | 8.03  |         |                                                    |  |  |  |
| Muscle                     | 5.77                    | 49.19  | 6.76   | 0.55  |         | 4.12 <sup>3</sup> H 1.10                           |  |  |  |
| Bone                       |                         | 38.78  | 6.40   | 0.51  | 0.059   |                                                    |  |  |  |

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|                            | Activity, pCi/g, dry wt |       |       |                  |            |                  |       |  |
|----------------------------|-------------------------|-------|-------|------------------|------------|------------------|-------|--|
| Sector D                   |                         |       |       |                  |            |                  |       |  |
| Ecosystem level            | <sup>40</sup> K         | Cs    | Sr    | <sup>60</sup> Co | 239,240 Pu | <sup>55</sup> Fe | Other |  |
| Soil                       |                         |       |       |                  |            |                  |       |  |
| Soil survey                |                         |       |       |                  |            |                  |       |  |
| No. 43                     |                         | 0.25  | 43.00 | 0.05             | 210.00     |                  |       |  |
| No. 2                      |                         | 0.21  | 1.20  | 0.12             | 0.37       |                  |       |  |
| Biota soil sample          |                         | 0.82  |       | 8.00             |            |                  |       |  |
| Plants                     |                         |       |       |                  |            |                  |       |  |
| Messerschmidia             |                         |       |       |                  |            |                  |       |  |
| argentea                   | 14.19                   | 2.28  | 0.64  |                  | 0.004      |                  |       |  |
| <u>Scaevola frutescens</u> | 14.16                   | 1.57  | 0.44  |                  | 0.004      |                  |       |  |
| <u>Cocos nucifera</u>      |                         |       |       |                  |            |                  |       |  |
| Meat                       | 6.39                    | 1.99  |       |                  |            |                  |       |  |
| Animals                    |                         |       |       |                  |            |                  |       |  |
| Rattus rattus (roof r      | at)                     |       |       |                  |            |                  |       |  |
| Muscle                     | 15.87                   | 3.74  | 0.63  |                  | 0.008      | 1.23             |       |  |
| Bone                       | 23.95                   | 23.80 | 1.32  | 1.31             | 0.058      |                  |       |  |
| Lung                       |                         | 11,55 |       |                  | 0.201      |                  |       |  |
| Viscera                    | 17.77                   | 5.69  |       | 0.20             | 0.020      |                  |       |  |
| Liver                      |                         | 4.62  | 10.54 |                  | 0.398      | 17.30            |       |  |
| Skin                       | 10.70                   | 3.94  |       |                  |            |                  |       |  |
| Kidney <sup>a</sup>        | 16.72                   | 6.19  |       |                  |            |                  |       |  |
| Anous stolidus (com        | mon nod                 | dy)   |       |                  |            |                  |       |  |
| Eggshell                   |                         |       | 0.22  |                  |            | 1.10             |       |  |
| Egg                        | 4.13                    |       |       |                  | 0.023      | 56.76            |       |  |

Table 93 (Continued).

 $^{\mathbf{a}}\text{Analysis}$  showed 167.20 pCi/g  $^{\mathbf{40}}\text{K}.$ 

Eci Soi Rai Me Soi No. No. No. Ме Bic <u>Pla</u> <u>Co</u>( Pis Mea <u>Sca</u> Ani Rat Liv Vis Mu: Kid Lur Skii Bor Anc Liv

Vis Mu Boi <u>Bir</u> Mu He Ex

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|                       | Activity, pCi/g, dry wt |                   |                  |                    |                       |                  |                     |  |  |
|-----------------------|-------------------------|-------------------|------------------|--------------------|-----------------------|------------------|---------------------|--|--|
| Ecosystem level       | 40 <sub>K</sub>         | <sup>137</sup> Cs | 90 <sub>Sr</sub> | - <sup>30</sup> Co | 239,240 <sub>Pu</sub> | <sup>55</sup> Fe | Other               |  |  |
| Soil                  |                         |                   |                  |                    |                       |                  |                     |  |  |
| Range                 |                         | 0.02-111          | 0.03-1.8         | 0.03-0.7           | 4 0.02-0.22           |                  |                     |  |  |
| Mean                  |                         | 0.40              | 0.59             | 0.12               | 0.08                  |                  |                     |  |  |
| soil survey           |                         |                   |                  |                    |                       |                  |                     |  |  |
| No. 4                 |                         | 0.59              | 0.30             | 0.08               | 0.02                  |                  |                     |  |  |
| No. 5                 |                         | 0.37              | 0.32             | 0.04               | 0.03                  |                  |                     |  |  |
| No. 6                 |                         | 0.20              | 0.03             | 0.04               | 0.04                  |                  |                     |  |  |
| Mean                  |                         | 0.327             | 0.22             | 0.05               | 0.03                  |                  |                     |  |  |
| Biota soil sample     | 0.64                    | 2.60              | 1.53             | 1.25               | 0.26                  |                  |                     |  |  |
| Plants                |                         |                   |                  |                    |                       |                  |                     |  |  |
| Cocos nucifera        | 5.93                    | 0.58              |                  |                    |                       |                  |                     |  |  |
| Pisonia grandis       | 17.76                   | 1.46              | 0.50             |                    |                       |                  |                     |  |  |
| Vesserschmidia        |                         |                   |                  |                    |                       |                  |                     |  |  |
| argentea              | 8.03                    | 1.16              | 0.33             |                    |                       |                  |                     |  |  |
| Scaevola frutescens   | 9.32                    | 0.75              | 0.88             |                    |                       |                  |                     |  |  |
| Animals               |                         |                   |                  |                    |                       |                  |                     |  |  |
| Rattus rattus (roof r | rat)                    |                   |                  |                    |                       |                  |                     |  |  |
| Liver                 | 30.20                   | 1.07              |                  | 1.62               | 0.013                 | 46.4             |                     |  |  |
| Viscera               |                         | 1.09              |                  |                    | 0.035                 |                  |                     |  |  |
| Muscle                | 5.21                    | 1.47              | 0.07             |                    | 0.009                 | 2.21             |                     |  |  |
| Kidney                |                         | 1.20              |                  | 3.19               |                       |                  |                     |  |  |
| Lungs                 | 35.88                   | 1.55              |                  |                    |                       |                  |                     |  |  |
| Skin                  | 8.07                    | 0.61              |                  |                    |                       |                  |                     |  |  |
| Bone                  | 18.81                   | 13.25             | 1.69             |                    | 3.28                  |                  |                     |  |  |
| Anous tenuirostris (  | white-                  | capped nod        | dy)              |                    |                       |                  |                     |  |  |
| Liver                 | 8.37                    |                   | 0.03             |                    | 0.022                 | 326.6            |                     |  |  |
| Viscera               |                         |                   |                  |                    |                       | 73.9             |                     |  |  |
| Muscle                | 7.10                    |                   |                  | 0.39               | 0.006                 | 41.3             |                     |  |  |
| Bone                  |                         |                   | 0.66             |                    |                       | 44.2             |                     |  |  |
| Birgus latro (coconu  | ut c <b>rab</b> )       | )                 |                  |                    |                       |                  |                     |  |  |
| Muscle                | 11.28                   | 1.98              | 0.18             | 0.20               |                       | 0.98             | <sup>3</sup> H 0.42 |  |  |
| Hepatopancreas        | 3.02                    | 0.42              | 0.13             | 0.20               |                       | 5.70             | <sup>3</sup> H 0.16 |  |  |
| Exoskeleton           | 2.59                    | 0.29              | 6.08             |                    | 0.001                 | 0.07             |                     |  |  |
|                       |                         |                   |                  |                    |                       |                  |                     |  |  |

Table 94. Distribution of radionuclides in terrestrial biota and soil on BRUCE, Enewetak Atoll, 1972-1973. 

|                                   | Activity, pCi/g, dry wt |                   |                  |                  |                       |                  |                     |  |
|-----------------------------------|-------------------------|-------------------|------------------|------------------|-----------------------|------------------|---------------------|--|
| Ecosystem level                   | 40 <sub>K</sub>         | 137 <sub>Cs</sub> | 90 <sub>Sr</sub> | <sup>60</sup> Co | 239,240 <sub>Pu</sub> | <sup>55</sup> Fe | Other               |  |
| Soil                              |                         |                   |                  |                  |                       |                  |                     |  |
| Range                             |                         | 0.03-1.0          | 0.08-2.6         | 0.01-0.1         | 4 0.01-0.23           |                  |                     |  |
| Mean                              |                         | 0.39              | 0,55             | 0.034            | 0.054                 |                  |                     |  |
| Soil survey                       |                         |                   |                  |                  |                       |                  |                     |  |
| No. 2                             | 0.38                    | 0.56              | 2.60             | 0.02             | 0.05                  |                  |                     |  |
| No. 3                             |                         | 0.45              | 0.32             | 0.03             | 0.01                  |                  |                     |  |
| Biota soil sample                 |                         | 0.36              | 0.41             | 0.03             | 0.02                  |                  |                     |  |
| Plants                            |                         |                   |                  |                  |                       |                  |                     |  |
| <u>Messerschmidia</u><br>argentea | 13.55                   | 1.09              | 0.46             |                  | 0.0061                |                  |                     |  |
| Messerschmidia<br>argentea        | 11.02                   | 7.24              | 0.76             |                  |                       |                  |                     |  |
| Messerschmidia<br>argentea        | 13.22                   | 2.58              | 1.06             |                  |                       |                  |                     |  |
| Messerschmidia<br>argentea        | 3.88                    | 15.84             | 0.75             |                  |                       |                  |                     |  |
| Scaevola frutescens               | 17.59                   | 1.11              | 0.34             |                  | 0.0005                |                  |                     |  |
| Scaevola frutescens               | 10.69                   | 4.82              | 0.37             |                  |                       |                  |                     |  |
| Scaevola frutescens               | 13.02                   | 5.18              | 0.31             |                  |                       |                  |                     |  |
| Scaevola frutescens               | 16.33                   | 2.01              | 0.56             |                  |                       |                  |                     |  |
| <u>Morinda</u> citrifolia         | 12.26                   | 3.51              | 0.02             |                  | 0.013                 |                  |                     |  |
| Pandanus tectorius                | 9.74                    | 15.90             | 3.56             |                  |                       | 0.13             |                     |  |
| Tacca<br>leontopetaloides         | 6.63                    | 1.09              | 0.46             |                  | 0.0061                |                  | <sup>3</sup> H 0.52 |  |
| Fimbristylis<br>atollensis        | 3.83                    | 7.39              |                  |                  |                       |                  |                     |  |
| Pisonia grandis                   | 19.02                   | 3.12              | 0.77             |                  | 0.0013                |                  |                     |  |
| Pisonia grandis                   | 10.2                    | 1.8               | 0.56             |                  | 0.0002                |                  |                     |  |
| Guettarda speciosa                | 4.00                    | 3.16              | 0.32             |                  |                       |                  | -                   |  |
| Cocos nucifera                    | 6.44                    | 2.59              | 0.01             |                  |                       |                  | <sup>3</sup> H 0.31 |  |
| Cocos nucifera                    | 3.76                    | 1.67              | 0.18             |                  |                       |                  | $10^{2}$ Rh 0.123   |  |
| Cocos nucifera                    | 4.69                    | 0.40              | 0.03             |                  | 0,0034                |                  |                     |  |
| Cocos nucifera                    |                         |                   |                  |                  |                       |                  |                     |  |
| Milk                              | 30.93                   | 23.32             |                  |                  |                       |                  |                     |  |

Table 95. Distribution of radionuclides in terrestrial biota and soil on DAVID, Enewetak Atoll, 1972-1973.

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|----------------|-----------------|-------------------------|------------------|------------------|-----------------------|------------------|-------------------------|--|--|--|--|--|
|                |                 | Activity, pCi/g, dry wt |                  |                  |                       |                  |                         |  |  |  |  |  |
| stem level     | 40 <sub>K</sub> | <sup>137</sup> Cs       | <sup>90</sup> Sr | <sup>60</sup> Co | 239,240 <sub>Pu</sub> | <sup>55</sup> Fe | Other                   |  |  |  |  |  |
| ls             |                 |                         |                  |                  |                       |                  |                         |  |  |  |  |  |
| bita perlatus  | (hermit d       | crab)                   |                  |                  |                       |                  | _                       |  |  |  |  |  |
| opancreas      | 7.61            | 1.95                    | 0.19             | 0.23             | 4.82                  | 0.57             | $^{3}$ H 0.95           |  |  |  |  |  |
| e              | 7.52            | 2.06                    | 0.31             | 0.28             | 0.0031                |                  | <sup>3</sup> H 0.58     |  |  |  |  |  |
| eleton         | 1.76            | 0.60                    | 4.05             |                  | 0.010                 | 0.04             |                         |  |  |  |  |  |
| 1 fuscata (soo | ty tern)        |                         |                  |                  |                       |                  |                         |  |  |  |  |  |
| e              | 7.46            |                         |                  |                  | 0.119                 | 59.0             |                         |  |  |  |  |  |
|                |                 | 0.74                    |                  |                  |                       | 37.4             | <sup>134</sup> Cs 0.413 |  |  |  |  |  |
|                | 20.36           |                         |                  |                  |                       | 153.20           |                         |  |  |  |  |  |
| ra             | 8.9             |                         |                  |                  |                       | 63.5             |                         |  |  |  |  |  |
| 1 acuminata (s | andpiper        | -)                      |                  |                  |                       |                  |                         |  |  |  |  |  |
|                | 17.57           |                         |                  |                  |                       |                  |                         |  |  |  |  |  |
|                | 28.16           | 0.79                    |                  |                  |                       |                  |                         |  |  |  |  |  |
| gretta sacra ( | reef herc       | on)                     |                  |                  |                       |                  |                         |  |  |  |  |  |
|                | 8.76            | 1.34                    |                  | 0.41             |                       |                  |                         |  |  |  |  |  |
| .e             | 4.65            | 1.59                    |                  |                  |                       |                  |                         |  |  |  |  |  |
| s exulans (ric | e rat)          |                         |                  |                  |                       |                  |                         |  |  |  |  |  |
| ra             | 12.24           | 21.97                   | 0.24             |                  | 0.0087                |                  |                         |  |  |  |  |  |
|                |                 | 16.36                   |                  |                  | 0.0042                | 3.67             |                         |  |  |  |  |  |
| .e             | 7.80            | 18.78                   | 0.60             |                  | 0.044                 | 0.98             |                         |  |  |  |  |  |
|                | 11.46           | 28.37                   | 1.37             |                  | 0.065                 |                  |                         |  |  |  |  |  |
|                | 6.49            | 9.13                    |                  |                  |                       |                  |                         |  |  |  |  |  |
| у              |                 | 17.0                    |                  |                  |                       |                  |                         |  |  |  |  |  |
|                |                 | 18.5                    |                  |                  | 0.031                 |                  |                         |  |  |  |  |  |

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|                             |                 |                  | <u>Activity</u> , | pCi/g, d         | iry wt                  |                  |
|-----------------------------|-----------------|------------------|-------------------|------------------|-------------------------|------------------|
| Ecosystem level             | 40 <sub>K</sub> | $\frac{137}{Cs}$ | 90 <sub>Sr</sub>  | 60 <sub>Co</sub> | 239,240 <sub>I</sub> -u | <sup>55</sup> Fe |
| Soil                        |                 |                  |                   |                  |                         |                  |
| Soil survey                 |                 |                  |                   |                  |                         |                  |
| No. 3                       |                 | 0.92             | 0.70              | 0.04             | 0.050                   |                  |
| No. 4                       |                 | 1.10             | 1.60              | 0.05             | 0.060                   |                  |
| No. 6                       |                 | 0.23             | 0.37              | 0.08             | 0.020                   | ~                |
| Mean                        |                 | 0.75             | 0.89              | 0.06             | 0,040                   |                  |
| Plants                      |                 |                  |                   |                  |                         |                  |
| Scaevola frutescens         | 6.36            | 0.49             |                   |                  |                         |                  |
| Messerschmidia<br>argentea  | 8,90            | 2.45             |                   |                  |                         |                  |
| Pisonia grandis             | 16.00           | 2.64             |                   | 0,091            |                         |                  |
| Animals                     |                 |                  |                   |                  |                         |                  |
| Anous stolidus (com         | mon nod         | dy)              |                   |                  |                         |                  |
| Eggshell                    |                 |                  | ~~~~              |                  |                         | 0.73             |
| Egg                         | 7.69            |                  |                   |                  | 0.0077                  | 51.4             |
| Liver                       | 4.89            |                  |                   |                  | *                       | 117.6            |
| Muscle                      | 10.81           |                  | 0.006             |                  | 0.0056                  | 43.5             |
| Bone                        |                 |                  |                   |                  |                         | 44.77            |
| Viscera                     |                 |                  |                   |                  |                         | 50.0             |
| <u>Coenobita perlatus</u> ( | hermit o        | erab)            |                   |                  |                         |                  |
| Hepatopancreas              | 5.83            | 0.78             | 0.30              | 0.57             | 0.0035                  | 1.82             |
| Muscle                      | 6.63            | 1.05             | 0.32              | 1.44             | 0.0026                  | 1.47             |
| Exoskeleton                 | 1.84            | 0.25             | 3.62              |                  | 0.001                   | 0.085            |

Table 96. Distribution of radionuclides in terrestrial biota and soil on REX, Enewetak Atoll, 1972-1973.

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|                            |                 |                   | Activity,        | pCi/g,           | dry wi                |                  |                     |
|----------------------------|-----------------|-------------------|------------------|------------------|-----------------------|------------------|---------------------|
| Ecosystem level            | 40 <sub>K</sub> | <sup>137</sup> Cs | <sup>90</sup> Sr | <sup>60</sup> Co | <sup>239,240</sup> Pu | <sup>55</sup> Fe | Other               |
| Soil                       |                 |                   |                  |                  |                       |                  |                     |
| Soil survey                |                 |                   |                  |                  |                       |                  |                     |
| No. 19                     |                 | 0.50              | 0.44             |                  | 0.100                 |                  |                     |
| No. 67                     |                 | 0.22              | 0.31             |                  | 0.060                 |                  |                     |
| No. 68                     |                 | 0.51              | 0.24             |                  | 0.020                 |                  |                     |
| Biota soil sample          |                 | 2.44              | 2.26             |                  | 0.19                  |                  |                     |
| Biota soil sample          | 0.40            | 0.40              | 0.71             |                  | 0.03                  |                  |                     |
| Plants                     |                 |                   |                  |                  |                       |                  |                     |
| Messerschmidia             |                 | 2 20              | 0 08             |                  |                       |                  |                     |
| argentea                   | 12 00           | 2.00              | 0.00             |                  |                       |                  |                     |
| Scaevola irutescens        | 13.60           | 2.40              | 0.27             |                  |                       |                  | 3.11 0.21           |
| <u>Cocos nucifera</u>      | 9.73            | 2.14              | 0.03             |                  |                       |                  | H 0.31              |
| Messerschmidia<br>argentea | 9.04            | 1.66              | 0.63             |                  |                       |                  |                     |
| Scaevola frutescens        | 11.83           | 1.47              | 0.62             |                  |                       |                  |                     |
| Cocos nucifera             | 5.50            | 3.45              |                  |                  |                       |                  |                     |
| Pandanus tectorius         | 8.86            | 3.09              | 25.14            |                  | 0.002                 | 0.41             |                     |
| Animals                    |                 |                   |                  |                  |                       |                  |                     |
| Rattus rattus (roof r      | rat)            |                   |                  |                  |                       |                  |                     |
| Viscera                    | 11.19           | 19.00             | 0.16             | 1.39             | 0.0074                |                  |                     |
| Liver                      | 11.12           | 15.60             | 0.018            |                  |                       | 0.93             |                     |
| Bone                       | 9.04            | 9.96              | 1.42             |                  | 0.23                  |                  |                     |
| Muscle                     | 10.3            | 18.4              | 0.06             |                  | 0.016                 | 0.10             | <sup>3</sup> H 11.3 |
| Skin                       | 6.5             | 7.6               |                  |                  |                       |                  |                     |
| Lung                       | 14.7            | 16.9              | 1.0              |                  | 0.14                  |                  |                     |
| Kidney                     | 21.8            | 15.0              |                  | 1.74             |                       |                  |                     |

Table 97. Distribution of radionuclides in terrestrial biota and soil on ELMER, Enewetak Atoll, 1972-1973.

|                              |                 | <u></u>           | Activity,        | pCig,            | dry wt                |                       |
|------------------------------|-----------------|-------------------|------------------|------------------|-----------------------|-----------------------|
| Ecosystem level              | 40 <sub>K</sub> | <sup>137</sup> Cs | 90 <sub>Sr</sub> | <sup>60</sup> Co | 239,240 <sub>Pu</sub> | Other                 |
| Soil                         |                 |                   |                  |                  |                       |                       |
| Soil survey                  |                 |                   |                  |                  |                       |                       |
| No. 18                       |                 | 0.16              | 0.85             |                  |                       |                       |
| No. 52                       |                 | 0.48              | 1.50             | 0.15             | 0.17                  |                       |
| Plants                       |                 |                   |                  |                  |                       |                       |
| Messerschmidia<br>argentea   | 11.23           | 0.56              | 0.43             |                  |                       |                       |
| Messerschmidia<br>argentea   | 8.83            | 1.78              | 0.49             |                  |                       |                       |
| Scaevola frutescens          | 10.36           | 0.65              | 0.23             |                  | 0.0006                |                       |
| Scaevola frutescens          | 7.14            | 3.80              | 0.81             |                  |                       | _                     |
| <u>Cocos</u> <u>nucifera</u> | 6.39            | 2.39              | 0.03             |                  |                       | <sup>3</sup> н 0.39   |
| Cocos nucifera               | 5.59            | 0.53              | 0.37             |                  |                       |                       |
| Pandanus tectorius           | 3.38            | 4.29              | 0.42             |                  | 0.0077                | <sup>55</sup> Fe 0.85 |

Table 98. Distribution of radionuclides in terrestrial biota and soil on FRED,<br/>Enewetak Atoll, 1972-1973.

Eco: Soil Rani Mea Soil No. No. No. Mean Biot Plan <u>Scae</u> <u>Scae</u> Mess ar Mess ar Pisoi Pisor Mori Mori: Coco: (m. <u>('oco:</u> (mi Anim Birgu Hepat Musc Exosl Coenc Hepat Exos Musc

Tab<sup>1</sup>

|                             |                 | -         | Activity,        | pCi/g,           | dry wt                |                  |                        |
|-----------------------------|-----------------|-----------|------------------|------------------|-----------------------|------------------|------------------------|
| Ecosystem level             | 40 <sub>K</sub> | 137 Cs    | <sup>90</sup> Sr | <sup>60</sup> Со | 239,240 <sub>Pu</sub> | <sup>55</sup> Fe | Other                  |
| Soil                        |                 | 0.01-0.25 | 0.00-3.0         | 0.01.0           |                       | -                |                        |
| Range                       |                 | 0.01 0.20 | 1 27             | 0.01-0.          | 23 0.005-0.20         |                  |                        |
| Mean                        |                 | 0.00      | 1.07             | 0.009            | 0.105                 |                  |                        |
| Soil survey                 |                 | 1 20      | 0.24             | 0 10             | 0 1 9                 |                  |                        |
| No. 15                      |                 | 1.20      | 0.24             | 0.12             | 0.13                  |                  |                        |
| No. 16                      |                 | 0.53      | 0.95             | 0.03             | 0.04                  |                  |                        |
| No. 17                      |                 | 0.58      | 0.71             | 0.02             | 0.04                  |                  |                        |
| Mean                        |                 | 0.77      | 0.63             | 0.06             | 0.07                  |                  |                        |
| Biota soil sample           |                 | 1.67      |                  | 0.13             | 0.30                  |                  |                        |
| Plants                      |                 |           |                  |                  |                       |                  |                        |
| Scaevola frutescens         | 12.84           | 0.64      | 1.54             |                  |                       |                  |                        |
| Scaevola frutescens         | 13.74           | 0.53      | 1.34             |                  |                       |                  |                        |
| Messerschmidia<br>argentea  | 21.81           | 1.24      | 2.05             |                  |                       |                  |                        |
| Messerschmidia              | 0 7-            | 1 07      | 0 51             |                  |                       |                  |                        |
| argentea                    | 9.75            | 1.27      | 2,51             |                  |                       |                  | 102                    |
| Pisonia grandis             | 25.79           | 1.86      | 2.88             |                  |                       | 0.81             | <sup>102</sup> Rh 0.17 |
| Pisonia grandis             | <b>30.</b> 28   | 3.91      | 1.74             |                  |                       |                  |                        |
| <u>Morinda</u> citrifolia   | 22.29           | 0.64      | 1.58             |                  |                       |                  |                        |
| Morinda citrifolia          | 14.16           | 0.76      | 0.40             |                  |                       |                  |                        |
| Cocos nucifera<br>(meat)    | 9.10            | 1.65      | 0.33             |                  |                       |                  |                        |
| Cocos nucifera<br>(meat)    | 8.28            | 1.30      |                  |                  |                       |                  |                        |
| Animals                     |                 |           |                  |                  |                       |                  |                        |
| <u>Birgus</u> latro (coconu | t crab)         |           |                  |                  |                       |                  |                        |
| Hepatopancreas              | 15.0            | 0.54      | 0.27             | 0.28             |                       |                  | <sup>3</sup> н 0.27    |
| Muscle                      | 10.45           | 1.88      |                  |                  |                       | 0.68             | <sup>3</sup> H 0 69    |
| Exoskeleton                 | 1.06            | 0.31      | 10.40            |                  | 0.0035                |                  |                        |
| Coenobita perlatus ()       | hermit          | crab)     |                  |                  | -                     |                  |                        |
| Hepatopancreas              | 8.68            | 1.51      | 0.43             | 1.12             | 0,006                 | 1.55             |                        |
| Exoskeleton                 | 1.52            | 0.25      | 9.14             |                  | 0.0011                |                  |                        |
| Muscle                      | 7.86            | 1.51      | 0.91             | 1.97             | 0.011                 | 1.32             |                        |

Table 99. Distribution of radionuclides in terrestrial biota and soil on GLENN, Enewetak Atoll, 1972-1973.

|                     |                 | Activity, pCi/g, dry wt |                  |                  |                       |                  |       |  |  |  |
|---------------------|-----------------|-------------------------|------------------|------------------|-----------------------|------------------|-------|--|--|--|
| Ecosystem level     | 40 <sub>K</sub> | <sup>137</sup> Cs       | 90 <sub>Sr</sub> | 60 <sub>Co</sub> | 239,240 <sub>Pu</sub> | <sup>55</sup> Fe | Other |  |  |  |
| Animals             |                 |                         |                  |                  |                       |                  |       |  |  |  |
| Rattus rattus (roof | rat)            |                         |                  |                  |                       |                  |       |  |  |  |
| Viscera             | 11.75           | 1.88                    | 0.28             | 2.06             | 0.036                 |                  |       |  |  |  |
| Liver               | 12.79           | 1.45                    |                  | 1.18             | 0.035                 |                  |       |  |  |  |
| Bone                | 10.61           | 6.02                    | 2.67             | 0.71             | 0.87                  |                  |       |  |  |  |
| Muscle              | 8.18            | 1.76                    | 1.03             | 0.48             | 0.017                 | 4.49             |       |  |  |  |
| Skin                | 2.3             | 0.33                    |                  |                  |                       |                  |       |  |  |  |
| Kidney              |                 | 1.46                    |                  | 2.40             |                       |                  |       |  |  |  |
| Lung                | 20.7            | 1.74                    |                  |                  | 0.30                  |                  |       |  |  |  |
|                     |                 |                         |                  |                  |                       |                  |       |  |  |  |

Table 99 (Continued).

Table 100.Distribution of radionuclides in terrestrial biota and soil on HENRY,<br/>Enewetak Atoll, 1972-1973.

|                             | Activity, pCi/g, dry wt |                   |                  |                  |                       |                  |                       |
|-----------------------------|-------------------------|-------------------|------------------|------------------|-----------------------|------------------|-----------------------|
| Ecosystem level             | 40 <sub>K</sub>         | <sup>137</sup> Cs | <sup>90</sup> Sr | <sup>60</sup> Co | 239,240 <sub>Pu</sub> | <sup>55</sup> Fe | Other                 |
| Soil                        |                         |                   |                  |                  |                       |                  |                       |
| Soil survey                 |                         |                   |                  |                  |                       |                  |                       |
| No. 7                       |                         | 0.01              | 0.24             | 0.01             | 0.21                  |                  |                       |
| No. 8                       |                         | 0.19              | 0.28             | 0.05             | 0.11                  |                  |                       |
| Biota soil sample           | 1.40                    | 0.98              |                  |                  |                       |                  |                       |
| Plants                      |                         |                   |                  |                  |                       |                  |                       |
| Messerschmidia<br>argentea  | 12.77                   | 0.52              | 1.98             |                  | <b>.</b>              |                  |                       |
| Scaevola frutescens         | 12.64                   | 0.19              |                  |                  |                       |                  |                       |
| <u>Morinda</u> citrifolia   | 17.01                   | 1.19              | 0.32             |                  |                       |                  |                       |
| <u>Cocos nucifera</u>       | 3.66                    | 0.70              |                  |                  |                       | ~                |                       |
| Animals                     |                         |                   |                  |                  |                       |                  |                       |
| <u>Coenobita perlatus</u> ( | hermit d                | rab)              |                  |                  |                       |                  |                       |
| Hepatopancreas              | 5.72                    | 1.17              | 0.50             | 0.98             |                       |                  |                       |
| Muscle                      | 7.69                    | 1.08              | 0.64             | 2.00             | 0.0066                | 0.98             |                       |
| Exoskeleton                 | 2.34                    | 0.24              | 9.64             |                  | 0.0009                | 0.08             |                       |
| <u>Anous</u> stolidus (com  | mon nod                 | dy)               |                  |                  |                       |                  | 65                    |
| Egg                         | 3.38                    |                   |                  |                  |                       | 54.1             | <sup>05</sup> Zn 0.79 |
| Eggshell                    |                         |                   |                  |                  |                       | 8.6              |                       |

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|                            | Activity, pCi/g, dry wt |                   |                  |                  |                       |                  |  |  |
|----------------------------|-------------------------|-------------------|------------------|------------------|-----------------------|------------------|--|--|
| cosystem level             | <sup>40</sup> K         | <sup>137</sup> Cs | 90 <sub>Sr</sub> | <sup>60</sup> Co | 239,240 <sub>Pu</sub> | <sup>55</sup> Fe |  |  |
| oil                        |                         |                   |                  |                  |                       |                  |  |  |
| oil survey                 |                         |                   |                  |                  |                       |                  |  |  |
| o. 6                       |                         | 0.08              | 0.57             | 0.06             | 0.03                  |                  |  |  |
| .o. 8                      |                         | 0.02              | 0.39             | 0.12             | 0.11                  |                  |  |  |
| lean                       |                         | 0.05              | 0.48             | 0.09             | 0.07                  |                  |  |  |
| iota soil sample           |                         |                   | 1.81             | 9.04             | 0.16                  | *                |  |  |
| lants                      |                         |                   |                  |                  |                       |                  |  |  |
| lesserschmidia<br>argentea | 17.71                   | 1.76              |                  | 0.25             |                       |                  |  |  |
| caevola frutescens         |                         | 9.42              | 0.52             |                  |                       |                  |  |  |
| is <b>onia gran</b> dis    | 12.66                   | 1.55              |                  |                  |                       |                  |  |  |
| u <b>ettarda</b> speciosa  | 13.74                   | 0.68              |                  |                  | ÷                     |                  |  |  |
| lorinda citrifolia         | 16.99                   | 2.23              | 1.85             |                  |                       |                  |  |  |
| nimals                     |                         |                   |                  |                  |                       |                  |  |  |
| irgus latro (coconu        | it c <b>ra</b> b)       |                   |                  |                  |                       |                  |  |  |
| luscle                     | 9.62                    | 1.25              | 0,079            | 1.05             |                       | 1.84             |  |  |
| e <b>patopan</b> creas     | 4.00                    | 0.32              |                  | 1.56             |                       | 12.80            |  |  |
| xoskeleton                 | 1.44                    | 0.22              | 5.9 <b>0</b>     | 0.11             | 0.002                 | 0.30             |  |  |

ible 101. Distribution of radionuclides in terrestrial biota and soil on JAMES, Enewetak Atoll, 1972-1973.

|                                                   | Activity, pCi/g, dry wt |                   |                  |                  |                       |                  |                    |
|---------------------------------------------------|-------------------------|-------------------|------------------|------------------|-----------------------|------------------|--------------------|
| Ecosystem level                                   | <sup>40</sup> K         | <sup>137</sup> Cs | <sup>90</sup> Sr | <sup>60</sup> Co | 239,240 <sub>Pu</sub> | <sup>55</sup> Fe | Other              |
| Soil                                              |                         |                   |                  |                  |                       |                  |                    |
| Soil survey                                       |                         |                   |                  |                  |                       |                  |                    |
| No, 7                                             |                         | 1.40              | 3.40             | 0.28             | 0.430                 |                  |                    |
| No. 9                                             |                         | 0.81              | 1.60             | 0.11             | 0.100                 |                  |                    |
| No. 11                                            |                         | 0.05              | 0.06             | 0.07             | 0.130                 |                  |                    |
| Biota soil sample<br>(coconut)                    |                         | 0.18              | 1.38             | 0.14             | 0.080                 |                  |                    |
| Biota soil sample<br>( <u>Pisonia</u> )<br>Plants |                         | 0.19              | 1.57             | 5.21             | 0.070                 |                  |                    |
| Messerschmidia<br>argentea                        | 12.45                   | 0.25              | 0.32             | 0.20             | 0.0044                |                  |                    |
| Scaevola frutescens                               | 15.52                   | 0.43              | 0.64             |                  |                       |                  |                    |
| Pisonia grandis                                   | 30.81                   | 3.65              | 3.00             |                  |                       |                  |                    |
| <u>Cocos</u> nucifera                             | 7.69                    | 0.95              |                  |                  |                       |                  |                    |
| <u>Guettarda speciosa</u>                         | 12.87                   | 0.47              | 1.74             |                  |                       |                  |                    |
| Pandanus tectorius<br>(leaves)                    | 12.70                   | 0.86              | 13.11            |                  |                       | 12.20            | <sup>3</sup> н 2.0 |
| Pandanus tectorius<br>(flower)                    | 8.18                    | 0.57              |                  |                  |                       | 0.36             |                    |
| Animals                                           |                         |                   |                  |                  |                       |                  |                    |
| Birgus latro (coconu                              | it crab)                |                   |                  |                  |                       |                  |                    |
| Muscle                                            | 10.11                   | 1.92              | 1.19             | 0.42             |                       | 1.46             |                    |
| Exoskeleton                                       | 3.35                    | 0.51              | 9.96             |                  | 0.0007                | 0.18             |                    |
| Hepatopancreas                                    | 3.20                    | 0.50              | 0.40             | 1.03             | 0,0098                | 6.17             |                    |
| Anous stolidus (com                               | mon noo                 | ldy)              |                  |                  |                       |                  |                    |
| Viscera                                           | 8.97                    |                   |                  |                  |                       | 8.02             |                    |
| Muscle                                            | 12.96                   |                   |                  | 0.45             | 0.001                 |                  |                    |
| Bone                                              | 3.80                    |                   |                  | 0.31             |                       | 68.5             |                    |
| Liver                                             |                         |                   |                  | 0.69             |                       |                  |                    |

Table 102. Distribution of radionuclides in terrestrial biota and soil on KEITH, Enewetak Atoll, 1972-1973.

| Activity of the business    |                      |                         |                  |                  |                       |                   |                        |  |  |
|-----------------------------|----------------------|-------------------------|------------------|------------------|-----------------------|-------------------|------------------------|--|--|
|                             |                      | netrvitý, per/g, dry wt |                  |                  |                       |                   |                        |  |  |
| Ecosystem level             | 40 <sub>K</sub>      | <sup>137</sup> Cs       | 90 <sub>Sr</sub> | <sup>60</sup> Co | 239,240 <sub>Pu</sub> | 5 <sup>5</sup> Fe | Other                  |  |  |
| Soil                        |                      |                         |                  |                  |                       |                   |                        |  |  |
| lange                       |                      | 0.5-10                  | 1.6-34           | 0.04-5.0         | 0.02-2.0              |                   |                        |  |  |
| Mean                        |                      | 3.2                     | 11               | 0.58             | 0.63                  |                   |                        |  |  |
| Soil survey                 |                      |                         |                  |                  |                       |                   |                        |  |  |
| No. 2                       |                      | 2.4                     | 15.0             | 1.60             | 0.88                  |                   |                        |  |  |
| No. 4                       |                      | 2.6                     | 9.2              | 2.2              | 0.89                  |                   |                        |  |  |
| lean                        |                      | 2.5                     | 12.0             | 1.9              | 0.88                  |                   |                        |  |  |
| Biota soil sample           |                      | 7.3                     | 11.8             | 3.6              | 2.23                  |                   |                        |  |  |
| Plants                      |                      |                         |                  |                  |                       |                   |                        |  |  |
| <u>locos nucifera</u>       | 4.10                 | 3.54                    | 0.19             |                  |                       |                   | <sup>102</sup> Rh 0.13 |  |  |
| caevola frutescens          | 13.29                | 1.80                    | 3.74             |                  |                       |                   |                        |  |  |
| Messerschmidia<br>argentea  | 15.09                | 4.71                    | 14.37            | 0.21             |                       |                   |                        |  |  |
| Pisonia grandis             | 34.27                | 10.17                   | 14.86            |                  |                       |                   |                        |  |  |
| Pandanus tectorius          | 7.99                 | 9.14                    | 1.69             |                  | 0.0022                | 0.21              |                        |  |  |
| Pandanus tectorius          | 30.2                 | 26.2                    | 16.26            |                  |                       |                   |                        |  |  |
| <u>\nimals</u>              |                      |                         |                  |                  |                       |                   |                        |  |  |
| <u>Birgus latro</u> (coconu | ut crab)             |                         |                  |                  |                       |                   |                        |  |  |
| Muscle                      | 8.80                 | 12.60                   | 1.58             | 1.23             | 0.003                 | 1.59              | <sup>3</sup> H 0.88    |  |  |
| Exoskeleton                 | 1.58                 | 2.52                    | 8.96             | 0.71             | 0.025                 | 0.17              |                        |  |  |
| lepatopancreas              | 2.54                 | 3.83                    | 2.58             | 0.84             | 0.004                 | 5.05              | <sup>3</sup> H 0.21    |  |  |
| <u>Inous tenuirostris</u> ( | whit <del>e</del> ca | apped node              | dy)              |                  |                       |                   |                        |  |  |
| luscle                      | 10.95                |                         |                  | 2.06             | 0.003                 | 64.4              |                        |  |  |
| liver                       |                      |                         | 0.40             | 2.83             | 0.007                 | 810.8             |                        |  |  |
| liscera                     | 7.82                 |                         |                  | 1.01             |                       | 71.6              |                        |  |  |
| 3one                        |                      |                         |                  | 0.94             |                       | 109.5             |                        |  |  |

Table 103. Distribution of radionuclides in terrestrial biota and soil on LEROY, Enewetak Atoll 1972-1973

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## Discussion of Survey Data

The data on terrestrial biota samples collected in the Enewetak Atoll survey are shown in Table 59. It should be emphasized that an attempt was made to obtain samples of the range of edible species important to the evaluation of potential dosages. If an organism was not collected on an island, it is most likely that it did not occur there in significant numbers or in sufficient density to be encountered by the survey crews in several hours of collecting effort. We sampled judiciously so as not to alter the ecological state by our presence or removal of specimens. Because of the construction and test activities on the northern islands, the biota on many islands were in early stages of recovery or ecological succession, and therefore characterized by a limited number of species from a rather small flora (St. John, 1960). On some islands, only two ubiquitous woody species, Messerschmidia argentea and Scaevola frutescens, were found with a few widespread indigenous or introduced herb, grass, and vine species.

A wide range of plant species was sampled in order to obtain information on the transfer of radionuclides from soil to plants; while not eaten by man, several species were collected to provide a broad background on soil-plant relationships. It is apparent in the survey data that considerable variation occurs in the uptake of radionuclides from the stratum by plants, and the inclusion of non food plant species in the collections provides greater perspective on this subject. Because most of the animals collected in the Enewetak survey were physically small, pooling of samples and organs from a single large sample of animals from a given island or area was necessary to obtain an adequate sample size for analysis. Therefore, the radionuclide data on mammals, birds, and land crustacea represent integrated or population values rather than single animal analyses.

In Table 59, the basic survey data are listed according to the island from which the samples were obtained. This information is essentially the biological data bank for evaluation of dose to man through the terrestrial food chain.

In Tables 60 to 75, the survey data are ordered on the species of organism and permit the range of radionuclide concentration in a single species throughout the Atoll to be observed in a single table. In Tables 76 to 103, the basic survey data are arranged by island and include the soil, plant, and animal data obtained from the site.

Data presented in Tables 60 to 75 will be discussed here to provide a detailed ecological description of the Enewetak terrestrial biota survey. In Table 60, the radionuclide concentrations in Messerschmidia argentea, a broadleaved evergreen tree which was collected throughout the Atoll, are listed. <sup>137</sup>Cs was found in <u>M. argentea</u> on every island. Highest concentrations were observed at the northern end of YVONNE (Runit), on JANET (Engebi), and on IRENE (Bogon). Elevated concentrations of  $^{137}$ Cs were found in Messerschmidia in islands from ALICE, across the northern arc of islands and

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south along the eastern rim of the Atoll to YVONNE. One value on DAVID (Japtan) of 15.84 pCi g <sup>137</sup>Cs is approximately 2-3 times the other values from that island. This sample had an unusally low potassium content.

Correlation between  $^{137}$ Cs and  $^{90}$ Sr radioactivity in Messerschmidia and other plant species was not generally high. The differential uptake of these two radionuclides is undoubtedly influenced by the character of the Atoll substratum or soil. Most soils develop in place from the chemical and physical crosional products derived from the geological parent materials, which on Enewetak Atoll is composed entirely of coralline or algal limestone, or calcium and magnesium carbonate. The low potassium content of the Atoll substratum, the lack of clay-size particles (usually responsible for potassium and cesium complexing in soils). and the alcareous nature of the Atoll substratum suggest differential movement of cesium and strontium.

Highest <sup>137</sup>Cs concentration occurred in the <u>Messerschmidia</u> collected at the northern end of YVONNE (Runit), and the highest <sup>90</sup>Sr in <u>Messerschmidia</u> was on IRENE. The southern chain of islands from GLENN (Igurin) to KEITH (Giriinian) have <u>Messerschmidia</u> trees (leaves) with concentrations of <sup>137</sup>Cs from 0.25 to 1.76 pCi/g. <u>Scaevola</u> <u>frutescens</u> leaf concentrations also fall in this range. Vegetation growing in the San Francisco Bay area (approximately 38° N latitude) in 1972 had a mean concentration of 0.25 pCi/g dry wt  $^{137}$ Cs<sup>\*</sup>, which is at the lower limit of concentrations observed in the southern arc of islands at Enewetak Atoll. Soil in the San Francisco area ranged from 0.01 to 0.10 pCi<sup>137</sup>Cs/g dry wt in 1972.

The levels of <sup>137</sup>Cs observed on the southern and eastern islands south of BRUCE are higher than expected from world background for the southwest Pacific area. In 1964, a radiobiological survey of Enewetak and Bikini Atolls was conducted by the University of Washington Laboratory of Radiation Biology, and levels of  $^{137}$ Cs in Messerschmidia and Scaevola on GLENN (Igurin) ranged from 2.4 to 5.0 pCi/g dry wt.<sup>†</sup> These southern islands received fallout from the peripheries of clouds which typically exited the Atoll toward the southwest. This is suggested by the elevated concentrations of <sup>137</sup>Cs in Messerschmidia, <u>Scaevola</u>, Pisonia, and Pandanus on LEROY (Rigili).

The radionuclide concentrations in <u>Scaevola frutescens</u> (Table 61) show patterns similar to those seen in <u>Messerschmidia</u>, but generally lower in value. Highest concentrations were again found on the northern end of YVONNE (Runit), where the maximum

A. D. Welander, K. Bonham, L. R. Donaldson, R. F. Palumbo, S. P. Gessel, F. G. Lowman, and W. B. Jackson, <u>Bikini-Enewetak Studies</u> <u>1964 Part I, Ecological Observations</u>. University of Washington Laboratory of Radiation Biology, Seattle, Rept. UWFL-93, Part I (1966).

P. H. Gudiksen, C. L. Lindeken, J. W. Meadows, and K. O. Hamby, Environmental Levels of Radioactivity in the Vicinity of the Lawrence Livermore Laboratory, 1972 Annual Report, Lawrence Livermore Laboratory, Rept. UCRL-51333 (1973).

<sup>137</sup>Cs concentrations in both species occurred. Maximum concentrations of <sup>60</sup>Co in both <u>Messerschmidia</u> and <u>Scaevola</u> were found on IRENE (Bogon) adjacent to Seminole crater. Highest <sup>239</sup>, <sup>240</sup>Pu concentrations were observed on the north end of YVONNE (Runit) in both <u>Messerschmidia</u> (0.766 pCi/g) and <u>Scaevola</u> (1.293 pCi/g). The highest <sup>90</sup>Sr value in Scaevola also occurred on YVONNE (Runit). There are 12 islands on which <u>Messerschmidia</u> or <u>Scaevola</u> had over 25 pCi/g of either <sup>137</sup>Cs or <sup>90</sup>Sr. These are:

| ALICE       | NANCY  |
|-------------|--------|
| CLARA       | PEARL  |
| IRENE       | RUBY   |
| JANET       | TILDA  |
| MARY        | URSULA |
| MARY/NANCY* | YVONNE |
|             |        |

The arc of islands bounded by ALICE (Bogallua) on the west and YVONNE (Runit) on the east embraces the portion of the Atoll with the highest levels of environmental radioactivity. This is reflected by the radionuclide concentrations in the dominant vegetation of those sites. Within this sector of the Atoll, the highest levels of environmental radioactivity in the biota were found on IRENE (Bogon), JANET (Engebi), and YVONNE (Runit). In Table 62, the  $^{137}$ Cs and <sup>90</sup>Sr concentrations in <u>Messerschmidia</u> and Scaevola on the three most radioactive islands are compared. From this table it is apparent that both 90 Sr and <sup>137</sup>Cs are higher in Messerschmidia than in Scaevola. No explanation for this species difference can be made from these data. <u>Scaevola</u> is thought to be slightly more halophytic or salt-tolerant

\*Small islet or bar between MARY and NANCY.

than <u>Messerschmidia</u>. The <sup>40</sup>K concentrations, and hence the stable potassium levels, were found to be some, what higher in <u>Scaevola</u>.

The concentrations of radionuclides on Cocos nucifera, the coconut palm, on the islands of Enewetak Atoll are shown in Table 63. On the northern and eastern arc of islands, from DAISY to YVONNE, the coconut palms were young and most of the trees were just beginning to bear nuts at the time of the survey. On JANET (Engebi) fruit-bearing coconut palms were found along the eastern, or seaward, side of the island. These collections on JANET, and two others on MARY and NANCY, had the highest concentrations of <sup>137</sup>Cs. Almost every high concentration of  $^{137}$ Cs in coconut milk was correlated with high  ${}^{40}$ K. Two high concentrations of <sup>55</sup>Fe were found in coconuts from IRENE and MARY. The only <sup>239, 240</sup>Pu detected in coconuts was found on IRENE (Bogon), in a radioactive area on the eastern side of the island.

The small tree, <u>Morinda citrifolia</u>, bears a soft, edible fruit. The leaves of this tree, and the fruit when available, were collected on 11 islands. Radionuclide concentrations in <u>Morinda</u> are given in Table 64. High <sup>137</sup>Cs concentrations were found in <u>Morinda</u> on the northeastern arc of the islands from KATE to VERA. The highest <sup>137</sup>Cs and <sup>90</sup>Sr values are observed on MARY.

A second small tree species, <u>Guettarda speciosa</u>, was collected on 13 islands (Table 65). It is apparently an early invader of bare or denuded habitats, or perhaps regenerates readily some-

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n tly adily from root stocks left in the ground. \* Elevated <sup>137</sup>Cs and <sup>90</sup>Sr concentrations were seen in <u>Guettarda</u> on BELLE, MARY, IRENE, and YVONNE.

The large tree, Pisonia grandis, which was not found on the Atoll north of KATE, was collected on 12 islands (Table 68). North of DAVID, Pisonia was found on five islands, two of which had been disturbed (KATE and NANCY) during the test period. On the southern islands from GLENN to LEROY, and on DAVID and BRUCE on the eastern side of the Atoll, Pisonia grandis forms almost mono-specific stands with essentially closed canopies. On the northern two islands (KATE and NANCY), scattered trees of **Pisonia** are reinvading the disturbed habitats which are typically dominated by Messerschmidia and Scaevola at this time. Pisonia collected on KATE, NANCY, and VERA had the highest <sup>137</sup>Cs and <sup>90</sup>Sr concentrations in the species on the Atoll. The plant species Pisonia appears to have a high potassium content from its <sup>40</sup>K concentration; some plants have more than 3% potassium in their leaves. The mean <sup>40</sup>K concentration in Pi<u>sonia</u> is 21.0 pCi/g, which is higher than any plant sampled except coconut milk. The Pisonia forest soon creates an organic

layer or mull in the soil of the island, and the potassium cycle of the site becomes enriched. The elevated levels of <sup>137</sup>Cs and <sup>90</sup>Sr in <u>Pisonia</u> on LEROY again suggest that this island received fallout from tests conducted to the northeast across the lagoon. The Pandanus tree, Pandanus tectorius, was found on 11 islands at Enewetak Atoll (Table 67). Two trees bore fruit at the time of the survey, one on BELLE in the northern part of the Atoll and the other on KEITH in the southern islands. The fruit of this plant had 1.35 times the <sup>137</sup>Cs concentration that leaves from the same plant had. <u>Pandanus</u> on LEROY had elevated <sup>137</sup>Cs levels which were seen in other trees on that island. A high uptake of <sup>90</sup>Sr is indicated by elevated levels of that radionuclide in <u>Pandanus</u> leaves on ELMER and KEITH, where soil concentrations are low.

In Table 68, radionuclide concentrations in miscellaneous plant species are given. Lepturus repens is an indigenous grass which invades disturbed sites on the islands, and may be locally abundant around bird rookeries. A sedge counterpart, Fimbristylis atollensis. is also found in meadow-like areas in open stands or savannahs of Messerschmidia, such as on the north end of JANET. Suriana maritima is a halophytic shrub species which was collected on the southern margin of Seminole crater on IRENE. Pluchea odorata is a low succulent shrub typically found on the edges of natural openings in the trees and was collected at the western end of the airstrip on JANET. Tacca leontopetaloides, or arrowroot, is a coarse herb which has a large edible corm or storage organ that is eaten after rigorous processing. It was found in abundance in deep organic soil on DAVID, and in small patches on some of the southern islands. Terminalia samoensis is a low shrub which was

<sup>&</sup>lt;sup>\*</sup>R. F. Palumbo, "Recovery of the Land Plants at Enewetak Atoll Following a Nuclear Detonation," <u>Radiation Botany 1</u>, 182 (1962).

observed and collected on one of the southern islands (IRWIN).

Lepturus had elevated concentrations of <sup>137</sup>Cs on MARY and SALLY, but concentrations were low on HELEN and IRENE, probably because collections were made on the beach where radioactivity levels are low. Fimbristylis, the sedge, collected from the margin of Seminole crater on IRENE had high <sup>137</sup>Cs. <sup>90</sup>Sr. <sup>60</sup>Co. and <sup>239, 240</sup>Pu concentrations. Suriana growing in the same area also showed an accumulation of the same radionuclides, especially  $^{60}$ Co, which is prominent in most of the collections from IRENE.

Pluchea odorata, another shrubby species, was collected on JANET and had high concentrations of <sup>137</sup>Cs and <sup>90</sup>Sr. This plant had the highest concentration of  $^{137}$ Cs of any plant on JANET.

Tacca leontopetaloides, or arrowroot, had low concentrations of radionuclides on DAVID, but no specimens were found on islands with higher levels of radioactivity. Hence, any tendency for accumulation of radionuclides in the underground storage organs cannot be evaluated. This is a commonly used food plant which can be cultivated on islands with deep organic soils.

The radionuclide concentrations in land crustacea (Tables 69 and 70), in both species of rats (Tables 71 and 72), and in birds (Tables 73, 74, and 75) will be discussed in the next section, where these organisms will be placed in the context of the location in which they were collected. They are compiled here to facilitate reference to a specific organism and its occurrence on the

islands of the Atoll, and to summarize radionuclide data for the animal species These animals are significant in the Atoll ecology because they are food organisms, or they play a role similar to that of man in the island ecosystem

The data on radionuclide concentrations in terrestrial biota have been combined with soil-survey data to produce an analysis of the island ecosystem at the time of the survey. Because of the highly variable distributions of soil radionuclide concentrations, it is probably not appropriate to use mean values of a radionuclide concentration in the soil, since they they may be high because of a few high values. To make this comparison as realistic as possible, data from the soilsurvey location closest to the vegetation and animal collection site have been used In most cases, a terrestrial biota soil sample was taken in the area in which the plant species were collected, and these data are also used in the ecosystem analysis. The terrestrial biota soil sample usually was taken to a depth of 5.0 cm and from an area of 30  $\rm cm^2$ . These soil samples often contained higher concentrations of radioactivity than the soil-survey samples, which were taken to 15-cm depths, because of the surficial nature of radioactivity in many areas. The mean value and range of soil radionuclide concentrations will also be given in this analysis.

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In Table 76, the analysis of ALICE is presented. Three plant species constituted the bulk of the vegetative biomass and no mammals were known to be present. The common noddy, Anous stolidus, was nesting on the island at the time of the survey.

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Messerschmidia argentea had <sup>137</sup>Cs concentrations that were about 1.6 times the maximum values for that radionuclide in soil on the island. The soil  $^{137}$ Cs concentrations in the closest survey point for the 15-cm depth were 13 pCi/g, . while the sample taken in the biota survey contained 69. 05 pCi/g. Radioactivity depth profiles on the island showed both isotropic depth distribution of <sup>137</sup>Cs and logarithmic depth decreases in radioactivity. The biota soil sample is probably biased toward high concentrations because of the possibility of sampling a highly active surface layer of soil which would have had as much as 100 pCi/g<sup>137</sup>Cs. Calculated concentration factors for <sup>137</sup>Cs in Messerschmidia therefore range from 3.2 to 17, depending upon which soil sample is considered appropriate.

Samples of the common noddy, <u>Anous</u> <u>stolidus</u>, were obtained on ALICE and, although the animals were collected on the land, their food base is derived from the lagoon or the sea. Radioactivity in birds exhibited a qualitative correlation with radioactivity levels found in the lagoon adjacent to their nesting site. Some species may be pelagic feeders, and their body burdens reflect radionuclide concentrations in the open sea.

Data obtained on BELLE are summarized in Table 77. Vegetation recovery on this island was studied by Palumbo (1962), and Welander\* presented data on BELLE obtained in a 1964 survey

of Enewetak Atoll. Three plant species were collected on BELLE, including a Pandanus which was bearing fruit at the time. Both Pandanus leaves and fruit showed a strong tendency to accumulate  $^{137}$ Cs from the soil. Three soil samples collected in the vicinity of the Pandanus plant had a mean  $^{137}$ Cs concentration of 44.3 pCi/g (Nos. 39, 42, and 52), which is close to the dense vegetative cover mean soil value of 48 pCi/g, indicating a concentration factor of about 20 for fruit and 15 for leaves. Soil samples (Nos. 32 and 33) collected by the soil-survey crews were adjacent to the Messerschmidia and Scaevola trees sampled, and their low radioactivity is reflected in the low concentrations of  $^{137}$ Cs in those two species. Guettarda occurred closer to the center of the island, where higher soil radioactivity occurred. These results agree with those presented by Welander, except that higher concentration factors are evident in the 1973 data. Concentration effects for  $^{90}$ Sr are seen in plants in BELLE but, in general, they are small. However, Pandanus leaves have slightly more than three times the soil concentration.

CLARA radioecological relationships are analyzed in Table 78. Two plant species were collected on the island. Two soil samples (Nos. 7 and 9) were collected in the vicinity of the plant samples, both of which were higher in radionuclides than the biota sample collected with the plants. Soil sample No. 7 appeared to be closest to the area sampled, and the radionuclide concentrations in it were used for comparison with the vegetation data. <u>Messerschmidia</u> showed a small concentration factor of

<sup>&</sup>lt;sup>\*</sup>A. D. Welander, "Distribution of Radionuclides in the Environment and Bikini Atolls," in <u>Proc. of Second</u> <u>National Symposium on Radioecology</u>, <u>Ann Arbor, Mich. 1967 (1969), p. 346.</u>

about three, while no large factors were observed for <sup>90</sup>Sr or for Scaevola.

Table 79 contains summary data of terrestrial biota and soil radioactivity on DAISY. Young, nut-bearing coconut palms were found on the island, but only a low level of <sup>137</sup>Cs and <sup>60</sup>Co was detected in the meat of the nut. Low levels of <sup>239, 240</sup>Pu were detected in both <u>Messerschmidia</u> and <u>Scaevola</u> in the presence of rather high levels in the soil. The biota soil sample collected at the plant collection site was higher than three soil-survey samples collected in the same general area.

Radionuclide concentrations in biota on IRENE are summarized in Tables 80 and 81. Five areas were sampled on this island, which has a crater at its western end. The area around the crater is generally more radioactive than the eastern part of the island. The five sample areas are listed and described in Table 80. In area E, along the eastern edge of the crater, integrated vegetation samples of Messerschmidia and Scaevola were collected. These samples were obtained by collecting 10 to 20 leaves from each of 25 trees in a transect along the eastern end of the crater; a small stand of young coconut palms was found in the dense growth on the eastern end of the island.

Three biota-survey soil samples were collected on IRENE, and the ecosystem analysis uses soil-survey data obtained in areas being sampled. An attempt was made to obtain a sample of rats on the island, but large numbers of hermit crabs and birds prevented this by tripping the traps and taking the bait. Plant samples from IRENE are characterized by higher levels of  ${}^{60}$ Co than are found in plants on other islance

Relatively low concentrations of all radionuclides except 55 Fe are found in coconuts on IRENE. High concentrations of  ${}^{40}$ K in coconuts, especially in coconut milk, have been found several times in the analyses made on Enewetak samples Plant samples collected in the B area generally have higher  $^{137}$ Cs concentrations than the A or C areas. Both Messerschmidia and Scaevola had high levels of 90 Sr. with a concentration factor of 13 occurring in Messerschmidia Biota soil sample B had a slightly higher  $^{137}$ Cs concentration, while  $^{60}$ Co was higher in the A-area soil sample. Suriana maritima, a large shrub growing on the eastern edge of the crater throwout, had the highest  ${}^{60}$ Co concentration found on the island, with a concentration factor for  ${}^{60}$ Co of about 22. This  ${}^{60}$ Co concentration was the highest found in plants on Enewetak Atoll.

Hermit crabs living on vegetal debris on IRENE had correspondingly high <sup>137</sup>Cs and <sup>60</sup>Co concentrations in hepatopancreas and muscle tissues. The hepatopancreas of these land crustacea typically contains elevated levels of <sup>60</sup>Co and <sup>239, 240</sup>Pu, as well as <sup>137</sup>Cs. The exoskeleton of hermit crabs had high concentrations of <sup>90</sup>Sr, an observation also made by Welander at Enewetak and Bikini.

Common noddys nesting on a grassy spit at the southern edge, or lagoon side, of the island had low levels of  ${}^{90}$ Sr,  ${}^{60}$ Co,  ${}^{55}$ Fe, and  ${}^{239,240}$ Pu in their tissues. The highest concentrations of radionuclides in the IRENE noddys was <sup>55</sup>Fe in the liver.

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The large island of JANET (Engebi) was sampled in nine areas. These sample areas or sectors are listed in Table 82 with a brief description of their location on the island. The ecosystem analysis of JANET is shown in Table 83.

High concentration factors for <sup>137</sup>Cs and <sup>90</sup>Sr are apparent for <u>Messerschmidia</u> and <u>Scaevola</u> in Sector A. In Sector B a strong concentration mechanism is seen in both <u>Messerschmidia</u> and <u>Scaevola</u> (10 to 20 times). A high <sup>239, 240</sup>Pu level in the soil resulted in an increase of this radionuclide in plant leaves.

In Sector C,  $^{137}$ Cs and  $^{90}$ Sr were the prominent radionuclides in the soil samples collected adjacent to the biota collection site, and both radionuclides were detected in the three plant species in the area. A high  $^{40}$ K and  $^{137}$ Cs level was found in coconut milk, but the level in coconut meat was lower. The concentration of  $^{137}$ Cs in <u>Messerschmidia</u> was 20 times the mean soil concentration.

In Sector D, the shrub <u>Pluchea</u> <u>odorata</u> had a concentration factor for  $^{137}$ Cs of approximately 31, while <u>Messerschmidia</u> had a concentration factor of only three. In Sector E, <u>Messerschmidia</u> and <u>Scaevola</u> had concentration factors for  $^{137}$ Cs of about 3 to 5 times the soil levels of  $^{137}$ Cs, but exhibited on concentration effect for  $^{90}$ Sr.

Near the most radioactive area on the island, Sector F supported a population of roof rats, <u>Rattus rattus</u>, which were trapped during the night. Concentration factors in plants for <sup>137</sup>Cs at this site ranged from 16 to 21, and in animals another factor of two is apparent over the

plant concentrations. In a 1964 survey, Welander<sup>®</sup> observed lower concentration factors on the same island. The variation that is seen from sector to sector in our data may account for these relatively small differences. Viscera and lung <sup>137</sup>Cs concentrations and <sup>239, 240</sup>Pu in the bones of the rats was also observed. Rat body burdens of radioactivity may be related directly to radionuclide concentrations in <u>Scaevola</u> and <u>Messerschmidia</u>, according to Jackson and Carpenter<sup>†</sup>, because these plants constitute more than 70% of the diet of the rats.

A similar relationship was seen in Sector G area, near a large blockhouse complex in the center of the island. A large population of roof rats was evident in this area, feeding even in the daylight. Soil radioactivity was composed of  $^{137}$ Cs. <sup>60</sup>Co, <sup>90</sup>Sr, and <sup>239, 240</sup>Pu, with approximately twice as much <sup>90</sup>Sr as <sup>137</sup>Cs. Both <sup>60</sup>Co and <sup>239, 240</sup>Pu appeared in the animal samples but not in the plant samples. Concentration factors for <sup>137</sup>Cs are about six for Messerschmidia and seven for Scaevola, while <sup>90</sup>Sr has factors of less than one for both types. Lung and viscera again have the highest values in rat organs. Localization of <sup>60</sup>Co and  $^{55}$  Fe in the liver, and  $^{90}$  Sr and  $^{239,240}$  Pu in the bone is evident in this series of animal samples.

In Sector H,  $^{137}$ Cs,  $^{60}$ Co,  $^{90}$ Sr, and  $^{239,240}$ Pu are apparent in four soil

<sup>\*</sup>Welander, op. cit.

<sup>&</sup>lt;sup>†</sup>W. B. Jackson and M. L. Carpenter, "Radioisotope Cycling in Terrestrial Communities at Enewetak Atoll," in <u>Proc. of Second National Symposium</u> <u>on Radioecology, Ann Arbor, Mich.</u> (1969), p. 644.

samples collected in the area. The soil again contains higher <sup>90</sup>Sr than <sup>137</sup>Cs concentrations. Concentration factors for both 90Sr and 137Cs are seen in Messerschmidia (3 and 120), and lower factors are found in Scaevola (1 and 24). Roof rats trapped in Sector H show the high concentration factors observed in Sectors F and G for <sup>137</sup>Cs. High concentrations of <sup>239, 240</sup> Pu were detected in viscera and lungs, suggesting ingestion and inhalation of plutonium particles from the surface soil stratum. Rodents preen their pelage frequently, and undoubtedly ingestion occurs in this manner.\* The highest concentration of <sup>90</sup>Sr in rats occurred in the bones.

Common noddys nesting in the area had an unusually high concentration of  $^{137}$ Cs in their livers. It is possible that they were eating some terrestrial materials which are high in  $^{137}$ Cs. Fish in the vicinity of JANET are not highly contaminated with  $^{137}$ Cs. Fish samples collected in the lagoon near JANET had maximum concentrations of 6.7 pCi  $^{137}$ Cs/g, but most were lower.

In Sector I, a sample of roof rats was obtained, and a three-level analysis of the area is possible. Soil-survey samples indicate a low level of  $^{137}$ Cs,  $^{239,240}$ Pu, and  $^{60}$ Co, with higher concentrations of  $^{90}$ Sr in the surface 15 cm of soil. Vegetation in this area showed small concentration factors of 3 to 4 over soil  $^{137}$ Cs concentrations. Rat  $^{137}$ Cs body burdens were about 30 times the plant concentrations, and therefore over 100 times for soil-to-animal transfer.

Concentration factors of 10 to 20 for  $^{60}$ Co were apparent for visceral organs over that which occurred in the soil of the area. Bone contained high concentrations of  $^{239,240}$ Pu and  $^{90}$ Sr. Liver and muscle contained  $^{55}$ Fe, and viscera (mainly gastrointestinal tract) contained  $^{90}$ Sr and  $^{239,240}$ Pu, as well as a high level of  $^{137}$ Cs. The soil-to-bone concentration factor for  $^{90}$ Sr was approximately five. Concentration factors for  $^{90}$ Sr in plants at Enewetak Atoll, however, are usually low.

Table 84 contains the radionuclide concentrations in biota collected on KATE. The biota-survey soil sample and the nearest soil-survey samples agree quite well in this analysis. The red-tailed tropicbird, <u>Phaethon rubricaudus</u>, was found nesting on this island and was collected for analysis. This is a valuable measurement because this bird is mainly a pelagic sea feeder and provides a southwest Pacific oceanic background value for biota radionuclide concentrations.

<u>Pisonia grandis</u> was collected on KATE and was not found north of this site. It contained a level of  $^{137}$ Cs approximately 55 times the soil  $^{137}$ Cs concentration in the area. It is interesting that the  $^{40}$ K value in <u>Pisonia</u> on KATE is in the same range as other tree species (~10 pCi/g), while on southern islands, in mature <u>Pisonia</u> forests,  $^{40}$ K values are in the range of 16 to 30 pCi/g. The KATE <u>Pisonia</u>  $^{40}$ K value is the lowest concentration found in the species on the Atoll. A small concentration factor of about two for  $^{60}$ Co was found in Pisonia.

The red-tailed tropic bird had almost no radioactivity in its body, except for a

<sup>&</sup>lt;sup>\*</sup> N. R. French, P. Hayden, and T. Tagami, "The Source of Ingested Radioactivity in Desert Rodents," <u>Health Physics 11</u>, 637 (1965).

small amount of <sup>137</sup>Cs in the bone.

A summary of radionuclide concentrations in biota collected on LUCY is made in Table 85. The biota-survey sample is higher than the two soil-survey samples obtained in the same locality, which agreed quite closely with each other. A low level of <sup>137</sup>Cs occurred in the two plant species, Messerschmidia and Scaevola. In the hermit crabs, which feed primarily on vegetal debris, there were higher levels of  $^{137}$ Cs and a relatively high concentration of <sup>60</sup>Co in the hepatopancreas. If the soil-survey data are used, concentration factors from soil to crab are more than 100 for <sup>137</sup>Cs and for <sup>60</sup>Co. In this ecosystem, the hermit crab may be considered a "grazing" arthropod, and the soil-plantanimal economy is closely coupled.

The ecosystem analysis of PEARL is given in Table 86. The soil-survey data for the PEARL collection sites agreed well with the biota-survey soil sample, and the average of the two values may be used. No concentration effect for  $^{137}$ Cs was seen in <u>Messerschmidia</u> and <u>Scaevola</u> at the collection site. <u>Scaevola</u> collected in an area indicated as radioactive by the aerial survey had higher concentrations of  $^{137}$ Cs and  $^{90}$ Sr.

Rice rats collected on PEARL in the sampled area exhibit concentration factors of approximately 100 from plant to animal, but only five from soil to animal.

The ecosystem analysis of URSULA is given in Table 87. Good agreement is seen in the soil-survey data and the biota-survey soil data. Low levels of the four prominent radionuclides occurred in the soils on URSULA. Concentration factors are seen for  $^{137}$ Cs in <u>Messerschmidia</u> and <u>Scaevola</u> in the range of 30 to 35. The rice rat population had lower levels of radionuclides in their organs than most of the vegetation sampled. The usual pattern of  $^{239,240}$ Pu and  $^{90}$ Sr in the bone and  $^{60}$ Co in the liver is again manifested in this sample series.  $^{55}$ Fe typically is concentrated in the livers of both mammals and birds.

Data on radionuclide concentrations in biota collected on SALLY is made in Table 88. This small island has experienced a considerable amount of recent disturbance, and the remnants of a partially recovered vegetation were sampled. Two soil-survey samples were obtained in the biota collection site. A biota soil sample was also collected. and it contained higher concentrations of all radionuclides found in the soil. The two soil-survey samples agreed relatively well, and the mean concentrations of these two samples will be used in this analysis. Held<sup>\*</sup> has described radionuclide accumulation at the interface between the organic soil or surface litter and the mineral horizon or stratum below. Most of the northern and northeastern islands do not have deep accumulations of organic litter on the surface, and this phenomenon may only be present on relatively undisturbed islands.

Low levels of <sup>60</sup>Co and <sup>239, 240</sup>Pu are present in the soils on SALLY, with slightly more than two times as much <sup>90</sup>Sr in the soil as <sup>137</sup>Cs. The grass

<sup>\*</sup> E. F. Held, S. P. Gessel, and R. B. Walker, Atoll Soil Types in Relation to the Distribution of Fallout Radionuclides, University of Washington Laboratory of Radiation Biology, Seattle, Rept. UWFL-92 (1965).

Lepturus repens shows a concentration factor of about 35 for <sup>137</sup>Cs andless than one for <sup>90</sup>Sr. <u>Messerschmidia</u>, <u>Scaevola</u>, and <u>Pandanus</u> exhibited only modest accumulation levels of <sup>137</sup>Cs (5 to 6). This <u>Pandanus</u> plant did not show the high concentration factor for <sup>137</sup>Cs in leaves that the specimen collected on BELLE did.

Table 89 contains a summary of radionuclide data obtained on TILDA. A soil-survey sample was collected in the area where biota were sampled, and a biota soil sample was also collected. The biota soil sample again has higher concentrations of radionuclides than the soil-survey sample.  $^{90}$ Sr concentrations in the biota soil sample are almost 10 times those in the soil-survey sample. Both the  $^{60}$ Co and the  $^{90}$ Sr concentrations in the biota soil sample are higher than the maximum concentrations for these radionuclides found by the soil survey.

The <sup>137</sup>Cs activity in plants shows some concentration effects, especially in <u>Pandanus</u>, which had a concentration factor of about 18, using the dense vegetative cover mean soil value. <u>Scaevola had three times and</u> <u>Messerschmidia had seven times the</u> concentration of <sup>137</sup>Cs in soil.

Radionuclide concentrations in biota collected on VERA are shown in Table 90. This heavily vegetated island has one of the northernmost examples of mature Atoll forest vegetation characterized by <u>Pisonia stands</u>. A soil-survey sample was collected close to the biota sample area, and a biota soil sample was collected in the same area. The <sup>90</sup>Sr and <sup>239, 240</sup>Pu concentrations in the biota soil sample were 6, 3 and 3. 9 times the levels in the soil-survey sample.  $^{137}$ Cs and  $^{60}$ Co concentrations in the two soil samples agreed quite well.

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Six plant species were collected on VERA. The presence of Pisonia and Pandanus as large plants is a good indicator of successional maturity of Atoll vegetation. The highest <sup>137</sup>Cs concentration in plants was in Pisonia. which had a concentration factor of about 24. Pandanus leaves showed a concentration factor for  $^{137}$ Cs of seven. Pandanus exhibited a concentration factor of nine for 90 Sr, which is a comparatively high value in plants. On BELLE a Pandanus plant had a 90 Sr concentration factor of three. The higher concentrations of radionuclides in the shallower biota soil sample on an island such as VERA, with a well-developed organic matter horizon on the soil surface, was observed on Rongelap.\* Most of the mineral cycling must take place in this organic layer, and it is a logical site for soluble radionuclides to be complexed to organic colloids.

Table 91 shows radionuclide concentrations in biota collected on WILMA. Two soil-survey samples were collected close to the biota sample site. These two samples were comparable in radionuclide concentrations, and the mean value will be used. Low levels of four radionuclides were present in the soil of WILMA, with slightly more than two times as much <sup>90</sup>Sr as <sup>137</sup>Cs.

<sup>\*</sup>D. W. Cole, S. P. Gessel, and E. E. Held, "Tension Lysimeter Studies of Ion and Moisture Movement in Glacial Till and Coral Atoll Soils," <u>Soil Sci. Soc.</u> <u>Amer. Proc. 25</u>, 321 (1961). )n | .

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ıdies ∃cial <u>Soc</u>. Three plant species were collected on WILMA, and they all had low levels of  ${}^{137}Cs$ , with more  ${}^{40}K$  than fission products in the plants.

Tables 92 and 93 contain radionuclide concentrations in biota collected on YVONNE. This long, narrow island was sampled at four sites to obtain a representative series of biota samples where the physiography was somewnat diverse, and where there was considerable variation in the radioactivity levels of the island. The locations of the five sample sites are described in Table 92.

The data obtained in Sector A of YVONNE are shown in Table 93. This area was at the north end of the island the most radioactive site of those sampled. Three soil-survey samples which were collected near the biota sample site exhibit some variation; one sample is considerably more radioactive than the other two. Mean soil radionuclide concentrations may be elevated because of this high value. <sup>90</sup>Sr was approximately five times higher in the soil of this area than <sup>137</sup>Cs. Concentration factors for  $^{137}$ Cs in Messerschmidia and Scaevola are quite high when the mean soil concentration is used to calculate the factor. With such a high concentration of <sup>137</sup>Cs in Messerschmidia and Scaevola, it is probable that the plants were growing on soil with high  $^{137}$ Cs concentration, and the use of the highest soil value is justified. Concentration factors when using the value for soil survey No. 141  $(47 \text{ pCi}^{137}\text{Cs/g of soil})$  become 120 for Messerschmidia and 14 for Scaevola. Only a small concentration mechanism is seen for 90 Sr in Messerschmidia (1.4).

Two large samples of roof rats were obtained in the area and, when pooled, provided two population samples of the mammals living in Sector A. Typical patterns of radionuclide localization in the mammalian body are apparent in these data. <sup>137</sup>Cs concentrations are highest in the muscle, bone, and viscera. Bone <sup>137</sup>Cs concentrations have been quite high in many of these animal samples, and similar bone levels were reported by Yamagata and Yamagata\* in humans. High concentrations of 239, 240 Pu in viscera and lung are produced by ingestion of particles, either in preening by the rats or in the process of eating plant materials. <sup>55</sup>Fe is detected in the highly vascularized tissues of liver and muscle. Concentrations of  $^{60}$ Co in the kidneys were five times the high soil concentration. The highest concentrations of 90 Sr were found in the bone.

The second site sampled on YVONNE, Sector B, was on the north end of the island, 150 yd south of Cactus crater. The vegetation and general topography were similar to those in the Sector A site.

Three soil-survey samples were obtained in the area, and one biota soil sample was collected. The larger surface area of the biota sample resulted in higher concentration of most radionuclides detected at the site. An average was taken of all four samples for comparison with the biota.

The concentration factor for <sup>137</sup>Cs apparent in <u>Messerschmidia</u> is about 47 and in <u>Scaevola</u> about 14. A concentra-

<sup>&</sup>lt;sup>\*</sup>N. Yamagata and T. Yamagata, "The Concentration of Cs in Human Tissues and Organs," <u>Bull. Inst.</u> <u>Public</u> <u>Health (Tokyo) 9</u>(2), 72 (1960).

tion factor of about two was found in the meat of the coconut for  $^{137}$ Cs. A small concentration factor of 2.4 for  $^{90}$ Sr was seen in <u>Messerschmidia</u>. Of the two common tree species, <u>Messerschmidia</u> showed the highest concentration factor for both  $^{137}$ Cs and  $^{90}$ Sr.

A small collection of roof rats, <u>Rattus rattus</u>, was obtained in the area, but the radionuclide concentrations were elevated much above the level observed in plants. Concentration factors from soil to animal were in the range 19 to 43 for  $^{137}$ Cs, and in the bone  $^{90}$ Sr was 4.75 times the concentration in the soil. High  $^{239, 240}$  Pu concentrations were seen in the bone and viscera.

The common noddy, <u>Anous stolidus</u>, was nesting on the island in Sector B, and a sample was obtained with a shotgun. Eggs showed little radioactivity, except for <sup>55</sup>Fe and a small amount of <sup>90</sup>Sr. The viscera of the bird, mainly the gastrointestinal tract, which would contain the food eaten recently, showed detectable levels of only <sup>55</sup>Fe. The livers of the noddys contained <sup>60</sup>Co and <sup>55</sup>Fe in rather high concentration.

Table 93 contains a summary of radionuclide concentrations in biota collected in Sector C on YVONNE. This area was mid-island along the short airstrip that extends east to west. Four soil-survey samples were obtained in the area, three of which showed general agreement; the fourth was somewhat higher. The mean concentrations of radionuclides in the soil from these samples will be used in this analysis. Soil radionuclide concentrations are in general low, except for <sup>239, 240</sup>Pu. <sup>90</sup>Sr is present in 2.2 times the concentration of <sup>137</sup>Cs.

Plants in Sector C were sampled several times, and the data show some rather wide variations, both between and within species. Of the three Messerschmidia samples, one contained 25 to 42 times the <sup>137</sup>Cs concentration of the other two. The same variation was seen in the concentrations of  $^{137}$ Cs in Scaevola. Comparatively high concentrations of <sup>239</sup>, <sup>240</sup> Pu were seen in the plants collected in this area, with one value as high as 1.29 pCi/g. One Scaevola collection had rather high concentration factors for the species, 286 for  $^{137}$ Cs and 34 for <sup>90</sup>Sr. With the soil radionuclide concentions exhibiting the variations shown in these data, it is possible that the high activity seen in a single collection in a series is due to a small, localized "hot" spot.

A sample of roof rats was easily obtained in this area, since they are quite numerous at the north end of YVONNE. The highest concentrations of radionuclides in these animals was due to  ${}^{137}$ Cs and occurred in the lungs and viscera. High concentrations of  $^{239, 240}$ Pu were also present in the lungs and viscera of these animals. Concentration factors are difficult to assess in this area because of the variation in plant radionuclide concentrations. Concentrations of  $^{137}$ Cs in the muscle of rats were about 23 times the concentration in the soil. The mean <sup>137</sup>Cs concentration of the plants in the area, exclusive of the high Messerschmidia (95.32 pCi/g) and Scaevola (609.90 pCi/g), is 7.33 pCi/g. Rat muscle exhibits a 6.7 concentration factor over  $^{137}Cs$ concentrations in plants.

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A summary of radionuclide concentrations in biota collected in Sector D on YVONNE is made in Table 93. Two soilsurvey samples were obtained in the area, and a biota soil sample was also obtained. The biota soil sample again is higher than the soil-survey samples in  $^{137}$ Cs and  $^{60}$ Co. One soil-survey sample is very high in  $^{137}$ Cs concentrations on this part of the island are not much higher than the southern arc of islands from GLENN to KEITH. Radionuclides in general are low in plants in this area.

Sector D area is at the south end of YVONNE. A small sample of roof rats was trapped in the area, and a collection of common noddy eggs was made. The rat organs and tissue had low levels of  ${}^{60}$ Co,  ${}^{90}$ Sr,  ${}^{55}$ Fe, and  ${}^{137}$ Cs. Lung and bone had the highest  ${}^{137}$ Cs burdens, with lower values occurring in the muscle, viscera, and liver. The livers had the highest  ${}^{55}$ Fe,  ${}^{90}$ Sr, and  ${}^{239,240}$ Pu concentrations. It appears that there were plutonium-contaminated areas at the southern end of the island, with only modest fission-product levels occurring in the area.

The eggs of the common noddy contained <sup>55</sup>Fe and a small amount of <sup>239</sup>, 240<sub>Pu</sub>.

Data on radionuclide concentrations in biota collected on BRUCE are given in Table 94. This completely vegetated island has a mature <u>Pisonia</u> forest on it which was apparently modified only slightly by test activities. The island is far enough from test areas to not have been affected by physical effects of weapons tests. Three soil-survey samples were collected in the area where biological samples were obtained. A biota soil sample was also collected in the area, and had radionuclide concentrations that were higher than any of the soil-survey samples used in this analysis. Slightly more <sup>137</sup>Cs than <sup>90</sup>Sr was present in the soil on BRUCE.

Scaevola frutescens had the highest  $^{137}$ Cs concentrations in plants, and the coconut palm nut meat had the lowest – less than 1 pCi/g. A low level of  $^{90}$ Sr was present in <u>Pisonia</u>, <u>Messerschmidia</u>, and <u>Scaevola</u>.

Coconut crabs, <u>Birgus latro</u>, were abundant on the island, and a sample of five was collected.  $^{137}Cs$ ,  $^{60}Co$ , and  $^{90}$ Sr were present in coconut crabs in low levels.  $^{137}Cs$  was present in the highest concentration in the muscle of the crabs. Less than 1 pCi/g of  $^{137}Cs$ ,  $^{60}Co$ , and  $^{90}Sr$  occurred in the hepatopancreas. As observed in other land crustacea,  $^{90}Sr$  was relatively high in the exoskeleton.

A sample of roof rats, <u>Rattus rattus</u>, was trapped on BRUCE. Low concentrations of  $^{137}$ Cs,  $^{60}$ Co,  $^{90}$ Sr, and  $^{239,240}$ Pu were detected in the rat organs. The highest radionuclide concentration in rat livers was  $^{55}$ Fe, with a low level of  $^{60}$ Co.  $^{137}$ Cs concentrations were higher in bone than in any other tissue.

White-capped noddys, <u>Anous</u> <u>tenuirostris</u>, were collected on BRUCE; the analysis of liver, muscle, and viscera showed low levels of all radionuclides.

In Table 95, radionuclide concentrations in biota collected on DAVID are shown. This large island is covered by dense <u>Pisonia</u> and <u>Ochrosia</u> on the eastern portions, with a scrub vegetation of <u>Messerschmidia</u> and <u>Scaevola</u> occupying areas disturbed by test activities on the island. Mature coconut palms occur on the western, or lagoon, side of the island and in the central portion. Five soilsurvey samples and two biota soil samples were obtained in the areas where biological samples were collected. Low concentrations, less than 1 pCi/g, of 137Cs, 90Sr, 60Co, and 239, 240 Pu were present in the soil on DAVID, and biotaand soil-survey samples exhibited good agreement.

Replicate samples of the major plant species were collected on DAVID to evaluate the island variations in vegetation radionuclide content. Four Messerschmidia and Scaevola samples were collected on the island and, except for one sample of Messerschmidia, exhibit general agreement within the species for the most prominent fission product.  $^{137}$ Cs. A single sample of Messerschmidia had 15. 84 pCi/g  $^{137}$ Cs, while the other three samples were in the range of 1 to  $8 \, pCi/g$ . This Messerschmidia sample had an unusually low <sup>40</sup>K concentration, approximately 25% of the value observed in the other three samples. The mean Messerschmidia <sup>137</sup>Cs concentration, including the high value, was 6.69 pCi/g, which would be a concentration factor of about 17, using a mean biota- and soilsurvey value of 0.40 pCi/g. The mean Scaevola <sup>137</sup>Cs concentration of 3.3 pCi/g indicated a concentration factor of about eight for the species.

A large <u>Pandanus</u> located in the central part of the island had the highest <sup>137</sup>Cs concentration in plants, except for coconut milk. The <u>Pandanus</u> concentration factor for 137Cs on DAVID was about 40.

The herb, <u>Tacca leontopetaloides</u>, was collected on DAVID. A large sample of the corms of this plant was collected in a meadow-like area on the western half of the island. The radionuclide concentrations are low, with <sup>137</sup>Cs and <sup>90</sup>Sr occurring in levels at or less than 1 pCi/g. The sedge, <u>Fimbristylis</u> <u>atollensis</u>, was very abundant on bare ground on DAVID and contained a low level of <sup>137</sup>Cs.

<u>Pisonia grandis</u>, which forms continuous stands of tall trees on the eastern half of DAVID, had low levels of <sup>137</sup>Cs and <sup>90</sup>Sr. High <sup>40</sup>K concentrations are seen on DAVID in this species and on most of the southern islands.

Cocos nucifera, the coconut, was collected from three sites on DAVID and had a mean concentration of <sup>137</sup>Cs of 2.66 pCi/g in the meat. The analysis of coconut milk, however, indicated that in the milk solids 23.32 pCi/g of  $^{137}$ Cs was present, and the high value of  ${}^{40}$ K indicated a potassium content in excess of 3.5%. This high concentration of  $^{137}$ Cs in coconut milk may be partially an analytical artifact. The whole coconut milk from DAVID coconuts contained 4.7% solids, and the coconut milk therefore would have a wet concentration of 1.09 pCi/g  $^{137}$ Cs. This value is in the same range as the coconut meat, which is 34.1% solids and has a  $^{137}$ Cs concentration of 1.30 pCi/g wet weight.

The hermit crab, <u>Coenobita perlatus</u>, was collected on DAVID, and three tissues were analyzed for radioactivity. enwas

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The hepatopancreas and muscle of these small land crabs contained small amounts of <sup>137</sup>Cs, <sup>60</sup>Co, <sup>90</sup>Sr, and <sup>239,240</sup>Pu. The sooty tern was collected on DAVID but was not particularly abundant there, probably nesting farther northward on the Atoll, where sandy spits and beaches such as those on CLYDE provided sites. Very low concentrations of radionuclides were found in the terns, although <sup>55</sup>Fe was present in the livers at a concentration of 153.2 pCi/g. A small amount of <sup>137</sup>Cs was present in the bone, and

Two other birds were collected on DAVID – the sandpiper, which is probably a migratory species at Enewetak Atoll, and the reef heron, which is indigenous. The sandpiper contained only a small amount of  $^{137}$ Cs. The reef heron had slightly higher concentrations of  $^{137}$ Cs in the bone and muscle, and a small amount of  $^{60}$ Co in the bone.

239, 240 Pu was detected in the muscle.

A sample of rice rats, <u>Rattus exulans</u>, was obtained on the western side of DAVID in the vicinity of the site where Tacca and Morinda were collected.

<sup>137</sup>Cs was the radionuclide in the highest concentration in the rice rats; the highest value was found in the bone. This localization of <sup>137</sup>Cs in the bone was also noted by Takizawa and Sugai<sup>\*</sup> in a study of human tissues in Japan. Highest values in the period 1962-1966 were found in the bones of people living in northern Japan. High bone concentrations of <sup>137</sup>Cs have been consistently noted in these analyses for mammals living in areas of high environmental radioactivity. A low concentration of  $^{90}$ Sr and  $^{239,240}$ Pu was found in the rice rats on DAVID.

Table 96 contains a summary of radionuclide concentrations in biota of the small island, REX. This island, although small in area, has mature Atoll vegetation on it. Three soil-survey samples were collected in the area in which biota samples were obtained. Low concentrations of the four radionuclides typically found on the islands occurred on REX, where slightly more <sup>90</sup>Sr than <sup>137</sup>Cs was present in the soil.

Three plant species were collected on REX, and the most prominent radionuclides were  ${}^{40}$ K and  ${}^{137}$ Cs. <u>Pisonia</u> and <u>Messerschmidia</u> had concentrations of  ${}^{137}$ Cs of about 2.5 pCi/g and <u>Scaevola</u> contained less than 1 pCi/g. Concentration factors were about three.

Hermit crabs, <u>Coenobita perlatus</u>, were abundant on the island, and a large collection was made. <sup>137</sup>Cs concentrations in hermit crabs did not exceed those observed in the soil or the vegetation. <sup>90</sup>Sr and <sup>60</sup>Co were detected in the muscle and hepatopancreas of hermit crabs in low concentrations. Low levels of <sup>239, 240</sup>Pu were also found in these tissues.

Common noddys were nesting on the island, and their tissues contained low concentrations of <sup>90</sup>Sr and <sup>239,240</sup>Pu. The concentration of <sup>55</sup>Fe in the liver of the common noddy was the highest radionuclide concentration found on this island.

An ecosystem analysis of ELMER is given in Table 97. Three soil-survey samples were obtained in the area of biota sampling, and two biota group soil

<sup>&</sup>lt;sup>\*</sup>Y. Takizawa and R. Sugai, "Plutonium-239, Strontium-90, and Cesium-137 Concentrations in Human Organs of the Japanese," <u>Arch. Environ. Health</u> 23, 446 (1971).

samples were also obtained. Three radionuclides were detected in the soil on ELMER, and a low level of  $^{40}$ K was found in one of the biota soil samples. One biota soil sample contained higher concentrations of  $^{137}$ Cs,  $^{90}$ Sr, and  $^{239, 240}$ Pu than the other three samples by factors of 2 to 11.

Four plant species were sampled on ELMER. <u>Pandanus</u> had the highest concentrations of  $^{137}$ Cs and  $^{90}$ Sr, which was concentrated 79 times over the soil concentration (mean soil-survey sample = 0.33 pCi/g  $^{90}$ Sr). Concentration factors for  $^{137}$ Cs are much lower, about 3 to 6.

A sample of roof rats, <u>Rattus rattus</u>, was obtained on ELMER by trapping at night.  $^{137}$ Cs and  $^{90}$ Sr were the only manmade radionuclides detected in rat tissues and organs.  $^{137}$ Cs in viscera, liver, and bone showed concentrations 25 to 46 times mean soil concentrations, and 5 to 7 times the plant concentrations.

Table 98 contains an analysis of the soil radioactivity and vegetation on FRED. A large number of soil samples were collected on FRED by the soil-survey group. Two soil-survey samples were collected in the general area in which vegetation samples were obtained. Low concentrations of four radionuclides were detected in FRED soil materials. Two samples did not agree very closely in the concentrations, differing by factors of 1.5 to 3 for 90 Sr and 137 Cs. 60 Co and 239, 240 Pu were detected in only one sample of the pair.

Four species of plants were sampled on FRED. <u>Pandanus</u> was again the highest in <sup>137</sup>Cs concentration but did not have the high concentration of <sup>90</sup>Sr that was observed in the same species on ELMER. Low levels of <sup>239</sup>, <sup>240</sup>Pu were detected in <u>Scaevola</u> and <u>Pandanus</u>.

A summary of radionuclide concentrations in biota collected on GLENN is given in Table 99. Three soil-survey samples were collected in the biota sample area, and one large-surface-area biota soil sample was obtained. The concentrations of <sup>137</sup>Cs in the biota soil sample were slightly higher than in the soil-survey sample, but in general, radionuclide concentrations in the two types of samples were comparable. All four samples will be averaged in this analysis. <sup>137</sup>Cs is the most abundant radionuclide in the soil.

Plants growing on GLENN have two fission-product radionuclides and one naturally occurring radioisotope in all of the species sampled. <sup>137</sup>Cs was present in Pisonia and Messerschmidia in concentrations of 1.2 to 3.9 pCi/g. with fractional picocurie/gram concentrations occurring in Morinda, Scaevola, and Cocos. 90 Sr concentrations were slightly higher than <sup>137</sup>Cs concentrations in all species except Cocos. The high levels of  ${}^{40}$ K and stable potassium in Pisonia seem to indicate a positive correlation between  $^{137}$ Cs concentration and stable potassium content. The Pisonia leaves contained 3.0 and 3.5% potassium on the basis of their <sup>40</sup>K concentrations. Only slight concentration effects are seen in the vegetation on GLENN for the typical radionuclide that is concentrated in the biota,  $^{137}$ Cs.

A sample of rice rats (<u>Rattus exulans</u>) was collected in the central portion of the island where they subsist on coconuts and other plant materials. <sup>137</sup>Cs and <sup>90</sup>Sr were the most prominent radionuSP W i

clides in the rat tissues, with the highest concentration occurring in the bone. The highest concentrations of  $^{60}$ Co occurred in the kidney, viscera, and liver.

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Two land crustaceans were collected on GLENN. The hermit crab, <u>Coenobita</u> <u>perlatus</u>, and the coconut crab, <u>Birgus</u> <u>latro</u>, were quite abundant in the <u>Pisonia</u> and coconut forest of the island. Small amounts of <sup>137</sup>Cs were present in the hepatopancreas of the hermit crab, which also contained <sup>60</sup>Co. <sup>90</sup>Sr and <sup>239,240</sup>Pu also occurred in hermit crab hepatopancreas in sub-picocurie/gram levels.

The coconut crabs on GLENN had small amounts of  $^{137}$ Cs in the muscle and hepatopancreas. Traces of  $^{60}$ Co and Sr were also detected in the hepatopancreas.

There was essentially no concentration effect for  $^{137}$ Cs from plant to animal in the crustacea on GLENN. A factor of approximately six times the soil  $^{137}$ Cs concentration was seen in the bones of rice rats. A mean  $^{137}$ Cs concentration for all plants on GLENN is 1.32 pCi/g dry wt, and most of the animal tissues are within a factor of two of this value, except for rat bone.

Data on radionuclide concentrations in biota collected on HENRY are summarized in Table 100. This island is in the southeastern arc of islands characterized by mature atoll forest vegetation with small, local disturbances on them. Comparatively deep, organic soils are found in the <u>Pisonia</u> forests, and the effects of bird guano deposits may be quite evident as cemented strata beneath the organic horizons. Two soilsurvey samples and a biota soil sample were obtained in the area sampled on HENRY. The biota sample contained a measurable concentration of <sup>40</sup>K, probably due to the high organic content. The highest soil concentration of <sup>137</sup>Cs was found in the biota soil sample. <sup>90</sup>Sr was approximately twice the <sup>137</sup>Cs concentration in the soil-survey samples.

Four species of plants were sampled on HENRY, and only two man-made radionuclides were detected. Low concentrations are seen for <sup>137</sup>Cs in plants; however, <u>Messerschmidia</u> exhibited almost an eightfold concentration factor for <sup>90</sup>Sr.

Hermit crabs, <u>Coenobita perlatus</u>, showed a small concentration effect for  $^{137}$ Cs and  $^{90}$ Sr, but a concentration factor of 66 for  $^{60}$ Co in the muscle.  $^{60}$ Co was not detected in the plants sampled.

Table 101 contains a summary of radionuclide concentrations in biota collected on JAMES. Two soil-survey samples and a biota soil sample were collected in the area studied. Low levels of  $^{137}$ Cs and  $^{60}$ Co were found on JAMES with higher concentrations of  $^{90}$ Sr and  $^{239,240}$ Pu. The biota soil sample contained higher concentrations of radionuclides than either of the two soilsurvey samples. The mean soil-survey data will be used in analyzing the JAMES terrestrial ecosystem.

Five plant species were collected on the island, and the prominent radionuclide in their leaves was <sup>137</sup>Cs. <u>Morinda</u> had <sup>137</sup>Cs concentrations 44 times those in soils, while <u>Scaevola</u> continued approximately 10 times as much. <sup>90</sup>Sr appeared only in <u>Morinda</u>, at a level 3.8 times the soil concentration.

Coconut crabs, <u>Birgus latro</u>, occurred in modest numbers in the areas around coconut palms in the <u>Pisonia</u> forest, where a sample of these crustacea was collected. Only small concentration factors were seen for  $^{137}$ Cs and  $^{90}$ Sr in the coconut crab. Again a concentration effect for  $^{60}$ Co is apparent in the muscle and hepatopancreas of the crab where concentration factors of 12 and 17 occur. No  $^{60}$ Co was detected in plants.

Data on radionuclide concentrations in biota collected on KEITH are summarized in Table 102. This island is the westernmost island in the southern arc of islands, and from its higher levels of environmental radioactivity it apparently received more fallout than islands to the east, such as GLENN and HENRY.

Three soil-survey samples and two biota soil samples were collected on KEITH. One biota soil sample was collected under <u>Pisonia</u> trees and another under coconut palms. Biota soil samples had less radioactivity than the 15-cm-deep soil-survey samples. Mean soil radionuclide concentrations on KEITH are several times the concentrations found on JAMES, but not quite as high as those found on LEROY to the west.

Six plant species were collected on KEITH. Two samples of large <u>Pandanus</u> plant were obtained, one of leaves and the other a mature fruit. <u>Pandanus</u> again showed a concentration effect (a factor of eight) for <sup>90</sup>Sr. A comparatively high <sup>137</sup>Cs concentration was measured in <u>Pisonia</u>, which had a concentration factor of about five.

Coconut crabs, <u>Birgus latro</u>, on KEITH contained four man-made radionuclides and  ${}^{40}$ K in their tissues. No concentration effects were seen for  ${}^{137}$ Cs and  ${}^{90}$ Sr in the coconut crabs.  ${}^{60}$ Co was found in the hepatopancreas and muscle but was not detected in plants on the island.

Common noddys nesting on KEITH had two radionuclides in their tissues,  $\frac{60}{Co}$  and  $\frac{239,240}{Pu}$  Pu in low concentration.

Table 103 contains a summary of radionuclide data in biota collected on LEROY. This island is in the southwestern quadrant of the Atoll and received fallout from tests conducted in the northeastern portion of the Atoll. Two soilsurvey samples were obtained in the areas sampled by the terrestrial biota group, and a biota soil sample was also collected in this area. The biota soil sample contained higher concentrations of all four radionuclides present on the island, except <sup>90</sup>Sr.

Five plant species were collected on LEROY, all of which contained  ${}^{137}$ Cs and  ${}^{90}$ Sr. Only the <u>Pandanus</u> contained a trace of  ${}^{239,240}$ Pu.  ${}^{137}$ Cs was present in highest concentration in the flowering stalk of <u>Pandanus</u>. <u>Pisonia grandis</u> had the highest  ${}^{40}$ K concentration of the plants collected.  ${}^{90}$ Sr was also the highest in <u>Pandanus</u>. If the mean soil-survey concentration is used, concentration factors for  ${}^{137}$ Cs are 3.6 for <u>Pandanus</u>, 4 for <u>Pisonia</u>, 1.8 for <u>Messerschmidia</u>, and 1.4 for the coconut palm, <u>Cocos nucifera</u>.

Coconut crabs, <u>Birgus latro</u>, were collected on LEROY, and their tissues contained low concentrations of the four radionuclides detected in the soil. Muscle of the coconut crab exhibited a 3.5 concentration factor for  $^{137}$ Cs in coconuts. No concentration effects were observed for  $^{90}$ Sr,  $^{60}$ Co, or  $^{239,240}$ Pu in the coconut crab.

White-capped noddys were nesting on

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## Conclu:

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taken up organic r the potas follows ti least in a

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the island, and a sample was obtained for radionuclide analysis. The birds appeared to be feeding in the lagoon adjacent to the island. The most abundant radionuclide in the birds was <sup>55</sup>Fe, which was highest in the liver and muscle.

### Conclusions

The distribution of radionuclides in the terrestrial biota throughout the islands of Enewetak Atoll generally conforms to the results of the environmental radiation survey. On islands with elevated levels of radiation, the biota contained elevated concentrations of radionuclides. The most prominent radionuclides are <sup>137</sup>Cs, <sup>90</sup>Sr, <sup>55</sup>Fe, <sup>60</sup>Co, and <sup>239, 240</sup>Pu.

Concentration factors are observed in many species, especially for  $^{137}$ Cs. Low concentration factors are observed for  $^{90}$ Sr in plants, with the exception of <u>Pandanus</u>. Uptake coefficients are generally very low (about 10<sup>-3</sup>) for  $^{239,240}$ Pu in plants, and only occasional concentration effects are seen for  $^{60}$ Co, typically in the livers of animals.

The most effectively transferred radionuclide within the terrestrial ecosystems of Enewetak Atoll appears to be  $^{137}$ Cs. This occurs for at least two reasons.  $^{137}$ Cs remains soluble in the Atoll soil or substratum, where it is taken up by plants and incorporated into organic matter. It then apparently enters the potassium pool of the ecosystem, and follows the kinetics of that element, at least in a superficial sense.

The chemical form of a radionuclide in the unusual substratum of the islands of Enewetak Atoll will affect its transfer within the ecosystem and the biota, especially on to man. <sup>90</sup>Sr, for example, which is present in higher concentrations in the substratum on many islands, is not as prominent in the biota because it is probably tied up as insoluble carbonates in the Atoll soil.

Radionuclides are apparently transferred from plants, where initial concentration effects take place, to terrestrial animals, either warm- or cold-blooded, where additional concentration effects occur. The efficiency of this transfer is somewhat difficult to describe from survey data whose main purpose was not functional research, but strong indications of the trophic relationships in atoll ecology are inherent in the data.

Radionuclides such as <sup>60</sup>Co and <sup>55</sup>Fe enter the elemental pools for those elements and are typically found wherever those elements accumulate or sequester in animal tissues. Livers, kidneys, and hepatopancreases are such sites in mammals, birds, and crustacea.

Most radionuclide distributions in elements of the terrestrial biota sampled in this survey conform to the classical patterns that have evolved in the development of radiobiological science: e.g., <sup>90</sup>Sr, <sup>137</sup>Cs, and <sup>239,240</sup>Pu have an affinity for bone, <sup>137</sup>Cs is also found in physiologically active tissues such as muscle, and <sup>55</sup>Fe and <sup>60</sup>Co typically are retained in the liver and kidney.

One difficult aspect in the analysis of these data has been the variation in the basic ecological conditions present on the islands surveyed throughout the Atoll. One might attempt to compare radionuclide concentrations within a single species, such as Messerschmidia

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velop generalizations from the spectrum argentea, or more appropriately Cocos of ecological conditions which were ennucifera, throughout the Atoll, but islands countered in the Enewetak survey must be in the northern part of the Atoll are remade cautiously. Thus, a concentration covering from severe physical disturbance. factor determined for a species which is The physiology of plants under such condicolonizing a catastrophically disturbed tions is undoubtedly different from those growing and reproducing under stable or habitat may be quite different for the same species growing in a stable environquasi-stable successional conditions in ment in climatic and edaphic equilibrium. undisturbed habitats in the southern part of the Atoll. Therefore, attempts to de-

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# AIR-SAMPLING PROGRAM

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## Introduction

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An air-sampling program was carried out on Enewetak to evaluate potential population dosages from inhalation of resuspended soil radioactivity, and to develop information on this pathway for guidance in cleanup and rehabilitation activities. The air-sampling program sought first to ascertain the level of any inter-island atmospheric transport of radioactivity which was reflected in elevated air levels in the Atoll in general, and second, to evaluate air levels in the vicinity of known elevated soil burdens of radioactivity.

To meet these objectives, sampling was carried out on FRED and DAVID, representing low soil radioactivity areas, and on JANET, SALLY, and YVONNE, representing areas with more significant soil contamination.

#### Air-Sampling Equipment

#### Ultra High-Volume Air Samplers (UHVS)

Two portable UHVS's (see Figs. 80 and 81, and Wells et al.<sup>\*</sup>) were obtained from Lawrence Livermore Laboratory (LLL) resuspension studies in progress on the Nevada Test Site and adapted to



Fig. 80. Truck-mounted portable ultra high-volume air sampler.

the special field conditions of the survey. These samplers were designed and built at LLL to provide the very high-volume flow rate needed to sample large volumes of air in short time intervals. The flow rate through the sampler was approximately 2000  $m^3/hr$ , or about 20-50 times the flow rate of more conventional highvolume samplers. A special low-ash polystyrene filter, Delbag Microsorban, is used with this sampler. The filter medium is over 99% efficient for particles of  $0.3 \,\mu\text{m}$  diameter, and has a filter collecting area of 1.25 m<sup>2</sup>. Samplers were powered on Enewetak by 15-hp gasoline engines and fueled for 40 hr of operation by 55-gal gasoline drums. The UHVS's were calibrated at Livermore for flow rate and total integrated volume by standard flowmeter measurements. Field air volumes were measured by an

<sup>&</sup>lt;sup>\*</sup>W. Wells, B. R. Clegg, and J. C. Taylor, <u>An Ultra-High Volume Air</u> <u>Sampler for the Collection of Airborne</u> <u>Particulates in Low Concentrations</u>, <u>Lawrence Livermore Laboratory report</u> in preparation (1973).



Fig. 81. Portable ultra high-volume air sampler.

integrating flowmeter which was verified by a pitot-tube, instantaneous-flow-rate indicator. One UHVS unit was mounted on a 1/2-ton truck for off-island use on an LCM (Landing Craft Mechanized) and was limited in deployment to islands accessible by this craft. The second UHVS unit remained on FRED for continuous measurements.

#### Low-Volume Air Samplers (VCS)

Specially instrumented hand-held vacuum cleaners were used to collect week-long air samples on FRED and YVONNE. These samplers filtered at a rate between 8 and 20 m<sup>3</sup>/hr. Approximate flow-rate-over-time-of-sampling was obtained by averaging the initial and final flow rates determined by direct measurement. The VCS units were powered by base electricity on FRED and by small gasoline generators on YVONNE. These generators were connected redundantly so as to improve power reliability of these inherently poor sources.

#### Andersen Cascade Impactors (ACI)

Two five-stage particle spectrometers (Fig. 82) were used to obtain data on the particle-size distribution of airborne radioactivity. These Andersen Cascade Impactors sampled at 34 m<sup>3</sup>/hr and separated five particle fractions on Fiberglas filter paper in the following increments: 0.1-1.1 $\mu$ m, 1.1-2.0 $\mu$ m, 2.0-3.3 $\mu$ m, 3.3-7.0 $\mu$ m, and >7 $\mu$ m.

#### Sampling Operations

Daily observations were made of rainfall, wind velocity, and relative humidity. Weather information was of sar vol and thrsan to e four

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Fig. 82. Five-stage particle spectrometer.

available every 6 hr from the Enewetak Coast Guard Station. On YVONNE, a battery-powered station was used to measure wind velocity over the duration of the air-sampling operation.

Table 104 provides a summary of all samples collected, time of sampling, volume of air filtered, wind velocities, and the precipitation record. Figures 83 through 88 show the locations of sampling stations. Soil data appropriate to each air-sampling location may be found in the figures of Appendix II.

#### FRED

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UHVS, VCS, and ACI samples (Table 104) were obtained from October 21 to 23, 1972, and from November 28 until December 19. The sampler location (Fig. 83) was such as to measure regional ocean background or air which crosses YVONNE, depending on the wind direction. East winds prevailed 80% of the time; however, for two periods, October 22-23 and December 11-14, moderately high winds from the NNE prevailed which would be expected to reflect any pickup and transport of radioactivity from YVONNE to the southern part of the Atoll.

#### DAVID

Sampling was carried out on DAVID with the portable UHVS from October 19 to 22, resulting in two separate daylong samples. The sampling station was in the central part of the island (Fig. 84), with the winds from the east and northeast.

The FRED sampling location served to measure regional ocean background levels and, at other times, depending on wind direction, to measure interisland transport. Ocean background was measured 80% of the sampling time during the typical east tradewinds. Samples UH5 and UH10 (128,000 m<sup>3</sup>) were taken during a 010-050° northeast wind which sampled air along populated areas of FRED, as well as inter-island air from YVONNE. Neither sample exhibited radionuclide levels above ocean values.

Blank samples of 1. 25 m<sup>2</sup> of the Delbag Micrasorban filter paper used in the UHVS samplers, when analyzed in the same way as the samples for which data are shown in Table 105, show  $^{239, 240}$ Pu levels as high as 0.6 pCi/total paper, or about 0.01 fCi/m<sup>3</sup> if a sample volume of 40,000 m<sup>3</sup> is assumed. These "background" levels have not been subtracted from the data in Table 105 since they appear to be quite variable; therefore, tabulated values for  $^{239, 240}$ Pu in the range of 0.01 fCi/m<sup>3</sup> or less should be used with the understanding that they may represent upper limits.

The JANET and SALLY sampling positions were downwind from the highest gamma levels observed in the aerial

|       | Sample No.        | Sampling<br>period (1972) | Particle-size<br>range, µm | Volume<br>m <sup>3</sup> | Wind<br>direction       | Wind speed,<br>knots | Precipitation,<br>in. |
|-------|-------------------|---------------------------|----------------------------|--------------------------|-------------------------|----------------------|-----------------------|
| RED   | UH3               | Oct 21-22                 |                            | 60,000                   | E, ENE                  | 9-10                 | . < 0.01              |
|       | UH5               | Oct 22-23                 |                            | 30,900                   | NE, NNE                 | 10-15                | 0.0-0.01              |
|       | UH6               | Nov 28-30                 |                            | 58,700                   | E                       | 18-20                | 0.01                  |
|       | UH7               | Nov 30-Dec l              |                            | 61,000                   | E, ENE                  | 15-21                | 0.01                  |
|       | UH8               | Dec 1-2                   |                            | 16,400                   | E                       | 15-18                | 0.0-0.01              |
|       | UH9               | Dec 7-11                  |                            | 101,000                  | NE                      | 15-20                | 0.40                  |
|       | UH10              | Dec 11-14                 |                            | 97,400                   | NNE                     | 11-17                | 0.25                  |
|       | UH11              | Dec 14-17                 |                            | 97,500                   | NE                      | 15-22                | 0.04                  |
|       | UH12              | Dec 17-19                 |                            | 74,000                   | NE                      | 23-24                | 0.01                  |
|       | UH13              | Blank                     |                            | (40,000                  | m <sup>3</sup> assumed) |                      |                       |
|       | VC11              | Nov 28-Dec 7              |                            | 1,640                    |                         |                      |                       |
|       | VC21              | Nov 28-Dec 7              |                            | 1,640                    |                         |                      |                       |
|       | VC12              | Dec 7-18                  |                            | 2,300                    |                         |                      |                       |
|       | VC22              | Dec 7-18                  |                            | 2,300                    |                         |                      |                       |
|       | A11A              | Nov 28-Dec 7              | (0.01-1.1)                 | 7,300                    |                         |                      |                       |
|       | A11B              | Nov 28-Dec 7              | (1.1-2.0)                  | 7,300                    |                         |                      |                       |
|       | A11C              | Nov 28-Dec 7              | (2.0-3.3)                  | 7,300                    |                         |                      |                       |
|       | A11D              | Nov 28-Dec 7              | (3.3-7.0)                  | 7,300                    |                         |                      |                       |
|       | AllE              | Nov 28-Dec 7              | (>7.0)                     | 7,300                    |                         |                      |                       |
|       | A12A              | Dec 7-18                  | (0.01-1.1)                 | 9,900                    |                         |                      |                       |
|       | A12B              | Dec 7-18                  | (1.1-2.0)                  | 9,900                    |                         |                      |                       |
|       | A12C              | Dec 7-18                  | (2.0-3.3)                  | 9,900                    |                         |                      |                       |
|       | A12D              | Dec 7-18                  | (3.3-7.0)                  | 9,900                    |                         |                      |                       |
|       | A12E              | Dec 7-18                  | (>7.0)                     | 9,900                    |                         |                      |                       |
| DAVID | UH1               | Oct 19-20                 |                            | 56,000                   | E, ENE, NE              | 6-10                 | 0.01                  |
|       | UH4               | Oct 21-22                 |                            | 36,400                   | NE, NNE                 | 10-15                | 0.0-0.01              |
| ANET  | UH21              | Dec 4-5                   |                            | 36,000                   | NE,E                    | 13-18                | 0.37                  |
|       | UH22              | Dec 5-6                   |                            | 22,800                   | E                       | 15-20                | 0.40                  |
|       | UH23              | Dec 8-9                   |                            | 19,800                   | NE, ESE                 | 9-15                 | 0.14                  |
| ALLY  | UH24              | Dec 13-14                 |                            | 34,400                   | NE, ENE                 | 8-18                 | 0.0-0.01              |
|       | UH25              | Dec 14-15                 |                            | 39,000                   | NNE, NE                 | 15-22                | 0.01                  |
| VONNE | UH26<br>(Pu area) | Dec 15-16                 |                            | 27,000                   | NE                      | 15-25                | 0.03                  |
|       | UH27<br>(Pu area) | Dec 16-17                 |                            | 34,000                   | NNE, NE                 | 20-25                | 0.03                  |
|       | UH28<br>(Cactus)  | Dec 17-19                 |                            | 21,400                   | NE                      | 22-24                | 0.01                  |
|       | VC31<br>(Pu area) | Dec 2-9                   |                            | 1,800                    |                         |                      |                       |
|       | VC41<br>(Pu area) | Dec 2-9                   |                            | 1,800                    |                         |                      |                       |
|       | A21A<br>(Pu area) | Dec 2-9                   | (0.01-1.1)                 | 5,700                    |                         |                      |                       |
|       | A21B<br>(Pu area) | Dec 2-9                   | (1.1-2.0)                  | 5,700                    |                         |                      |                       |

Table 104. Air samples collected on Enewetak Atoll.

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| Table 104 (continued) | ١. |
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|        | Sample No.        | Sampling<br>period (1972) | Particle-size<br>range, μm | Volume<br>m <sup>3</sup> | Wind<br>direction | Wind speed,<br>knots | Precipitation,<br>in. |
|--------|-------------------|---------------------------|----------------------------|--------------------------|-------------------|----------------------|-----------------------|
| YVONNE | A21C<br>(Pu area) | Dec 2-9                   | (2.0-3.3)                  | 5,700                    |                   |                      |                       |
|        | A21D<br>(Pu area) | Dec 2-9                   | (3.3-7.0)                  | 5,700                    |                   |                      |                       |
|        | A21E<br>(Pu area) | Dec 2-9                   | ( >7.0)                    | 5,700                    |                   |                      |                       |
|        | VC32<br>(Pu area) | Dec 9-19                  |                            | 2,100                    |                   |                      |                       |
|        | VC42<br>(Pu area) | Dec 9-19                  |                            | 2,100                    |                   |                      |                       |
|        | VC43 (Pu          | area) (blind sam          | ple)                       |                          |                   |                      |                       |
|        | A22A              | Dec 9 <b>-1</b> 9         | (0.01-1.1)                 | 7,750                    |                   |                      |                       |
|        | A22B              | Dec 9 <b>-1</b> 9         | (1, 1-1, 1)                | 7,750                    |                   |                      |                       |
|        | A22C              | Dec 9 <b>-1</b> 9         | (2.0-3.3)                  | 7,750                    |                   |                      |                       |
|        | A22D              | Dec 9 <b>-1</b> 9         | (3.3-7.0)                  | 7,750                    |                   |                      |                       |
|        | A22E              | Dec 9-19                  | (>7.0)                     | 7,750                    |                   |                      |                       |

survey. All of these samples, however, exhibited the type of results observed on the FRED samples.

As an extreme test of resuspension, the UHVS was located in an area of highest plutonium surface contamination on YVONNE (Fig. 88). Both UHVS samples at that location exhibited measurable plutonium levels (1.8 and 2.6  $fCi/m^3$ ). The UH27 sample returned a detectable  $^{241}$ Am value of 0.30 fCi/m<sup>3</sup> ± 32%. Only one ACI sample measured a high <sup>239, 240</sup> Pu value (0. 18-fCi/m<sup>3</sup>), but that was in the respirable range of particle sizes (<1.1 um). In addition, one VCS sample taken during the same period (Dec. 2-9, 1972) exhibited a high value of  $^{239,240}$ Pu (0.41 fCi/m<sup>3</sup>). Other low-volume and cascade-impactor samples yielded plutonium air concentrations similar to those observed on FRED.

A resuspension factor can be inferred at the high plutonium site on YVONNE if one assumes that an average 200 pCi/g plutonium soil concentration in the top centimeter is available for suspension on the surface layer. The 2.6 fCi/m<sup>3</sup> air concentration (UH27), for example, indicates an approximate resuspension factor of  $10^{-9}/m$ .

Two days of sampling near the CACTUS crater measured a <sup>239-240</sup>Pu air concentration equal to 1.1 fCi/m<sup>3</sup> and a <sup>238</sup>Pu concentration equal to 0.13 fCi/m<sup>3</sup>. No detectable <sup>241</sup>Am was found. Such a high air concentration is somewhat anomalous because the surface plutonium concentrations in this area are not known to be nearly so high as at the central YVONNE site. Ocean spray is a possible source, because the CACTUS crater water contains a surface concentration of 200



Fig. 83. Air-sample station location, Fred B.

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Fig. 84. Air-sample station location, David.

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Fig. 85. Air-sample station location, Janet.

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Fig. 86. Air-sample station location, Sally.

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